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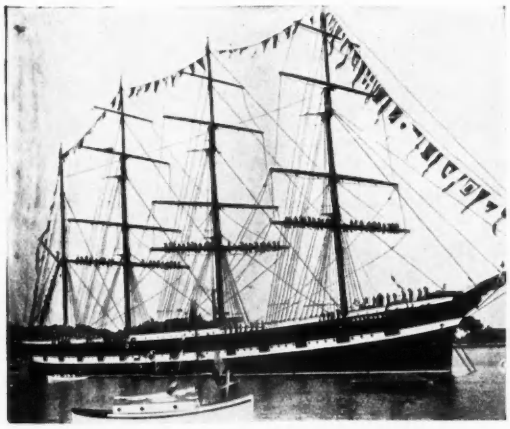

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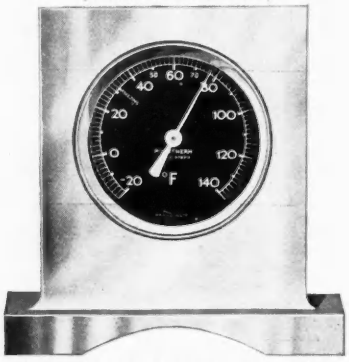

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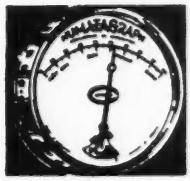

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Notes of the Month.

An accidental view of the Members' Calendar of the Royal Dublin Society—now in its 205th session, which began in November, 1935—gave immediate rise to a wonder why such an institution does not exist in the only large island now left to John Bull. We may be pardoned for saying that Discovery itself is one of the few institutions in Great Britain that even attempts what the Royal Dublin Society achieves: a well-proportioned mixture of science and the arts. A glance through the names of the lecturers gives sufficient warranty of the standard of the fare provided and the artists contributing to the programmes of music (a field in which Discovery can never hope to follow) are of the highest standing in the profession. We take this occasion to add our tribute to the regrets that members of the R.D.S. must feel over the untimely death that will preclude the delivery of Sir John McLennan's promised lecture on Low Temperature Phenomena. But Science marches on, and there will be no difficulty in finding a speaker glad to add his name to the list of those who serve this honoured Society. The Dublin Horse Show is *not* (as many may have supposed) the only activity of the R.D.S.

* * * *

We have often commented in these columns on the lack of organisation in museums, leading to lack of public appreciation of their contents. Directors of those museums which come under the suzerainty of the London County Council will have to look to their laurels, as they are about to receive organised visits from the most critical visitors in the world—parties of London schoolchildren. Dr. L. W. G. Malcolm, whose work at the Wellcome Historical Medical Museum is deservedly well-known, has been appointed to the newly-created post of Organiser of Museums to the L.C.C.; his duty is to co-ordinate the museums of the metropolis with the Council's education system. This will afford museum directors an admirable opportunity to bring and keep their museums in line with the inquiring minds of the younger generation. We wish them and Dr. Malcolm every success in this strenuous task.

* * * *

The Imperial War Museum, closed to the public at 6 p.m. on November 11th, will reopen at its new home in Lambeth next summer. The library, photographic reference and sales section, air photographs and map section, and other reference sections of the museum will remain accessible to the public, as previously, at 178, Queen's Gate, S.W.7, from 10 a.m. to 5 p.m. on Monday to Friday, and from 10 a.m. to 1 p.m. on Saturday, until further notice. The offices of the museum also will remain there for the time being.

* * * *

To the outsider, the most interesting feature in the *Report of the Eton College National History Society* (1934-35) is that part of it which deals with the College Bird Sanctuary. An area of Thames-side osier bed has been leased and fenced, and generally arranged in such a way as to be most attractive to birds. The marshy nature of the ground does not allow much scope for variety of vegetation, but boys otherwise unemployed have spent their leisure in raising the ground-level of part of the area to allow for suitable replanting. The effort to attract wild birds has already met with some success, but like all such places, the sanctuary has been visited by marauders. The ordinary egg-thief is bad enough, but, perhaps from the very nature of the case, this enclosure has been visited by a more determined

type of hooligan, whose aim is destruction for destruction's sake. An interesting addition to the Society's museum is the stuffed body of a peregrine falcon shot on the Berkshire Downs—a suggestive note for the student of bird-habitats who has relegated this falcon to the most desolate fastnesses of Wales.

* * * *

The ubiquitous termite (writes a correspondent of *The Times*) has shown its universal disrespect for human activities by attacking no less a building than Longwood, Napoleon's last residence on the island of St. Helena. How the destructive insect reached the island, of which it is not a native, is unknown, but it can travel long distances on the African mainland, and a few days' journey in the cargo of a swift ship has presumably offered no obstacle to its passage. The consequence has been the reconstruction of part of the Napoleonic homestead in reinforced concrete (by the society *Les Amis de Sainte-Hélène*), but Napoleon's actual quarters have been preserved in their original wooden form by the special preservative methods that modern entomological research has made available. It is hoped that these will prove efficacious.

* * * *

It is proposed to devote the major part of next month's issue of DISCOVERY (January, 1936) to a series of articles dealing with Australasia and the Pacific. The "mystery" of the South Sea Islands is very largely a thing of the past nowadays, but much important scientific research is being carried on in the area, especially in Melanesia and Northern Australia. The interior of New Guinea, for example, was a completely blank area on the map only a few years ago, but recent travellers have crossed the mountain backbone between British New Guinea and the Mandated Territory on several recent occasions. The magnificent work of Malinowski and his disciples on the anthropology of the Melanesians is another aspect of local research with far-reaching effects, and his latest work, an exhaustive study of the Trobriand Islanders, will be fully reviewed in our columns. Australia and New Zealand, too, are becoming more than ever conscious of their position as the great civilising factors in the Southern Pacific, and we look forward to correspondence from our many Australasian readers on the current vital developments in their sphere.

* * * *

The rooms of the Royal Photographic Society have been occupied throughout the preceding month by an Exhibition of Kinematography. In comparison with previous years, stress was laid on the technical aspect of the kinematic art and an attempt has been made to suggest the many technicians and the varied processes and instruments that bear their part in "The Life of a Film." Among the professional "stills," those exhibited by Science Films, Limited, were particularly interesting to the scientist, and Mr. H. Freeman offered some remarkable amateur "stills" illustrating the Living Cell. Apparatus shown on the upper floor was fully described in the catalogue, and the demonstration of colour-film apparatus was particularly informative. The efforts to deal with that bugbear of the enlarged film—graininess in emulsion—showed that real progress is being made towards an improvement in this direction.

* * * *

Great activity has been displayed latterly in the construction and enlargement of university libraries. The impressive new building at Cambridge is, of course, well known by now, and the great pile in the heart of Bloomsbury that is to house the books of London University, will doubtless soon be a familiar landmark on the metropolitan horizon. Within the last month or so, moreover, two important additions of the kind have been made to other English universities. The opening of the Edward Turner Sims Library, at University College, Southampton, by the Duke of York, is another step towards the realisation of the University of Wessex, an appropriate establishment in the kingdom of Alfred, the first truly English scholar. The building will not only house the library but will be the main entrance to the rapidly-growing group of academic edifices of which Southampton is justly proud. At the same time the University of Leeds acquired the Brotherton Library, valued at over £100,000, part of the munificent bequest of Lord Brotherton, along with Roundhay Hall, in which the library is at present accommodated. The collection is particularly notable for its works of English literature and history, and includes a Caxton and the four folios of Shakespeare. Continuity of tradition is maintained by the continuance of Mr. J. A. Symington's librarianship; so that future requirements in the way of books will be in safe hands.

* * * *

A Power Farming Conference will be held in Oxford in January next, under the auspices of the School of Rural Economy, the Institute for Research in Agricultural Engineering, and the Agricultural Economics Research Institute. The date provisionally fixed for the Conference is January 7th to 10th, and detailed notices of the programme can be obtained from the Institute for Research in Agricultural Engineering, Parks Road, Oxford.

A Theorist in the Theatre.

By W. A. Darlington.
Dramatic Critic of the Daily Telegraph.

Modern "symbolism" threatens danger to one of the greatest of the arts: the Drama. Mr. Darlington shows how fallacious are the premises on which the "new" drama is based. He writes from long experience of the Theatre, and his arguments are based not only on artistic, but on historical grounds.

Of all the silly forms of behaviour invented by human beings, snobbery is the most irritating. Of all brands of snob, the most tiresome is the literary snob. If a literary snob is bad, a didactic literary snob is worse, and a didactic and inaccurate literary snob is worst of all. Mr. W. H. Auden, in a manifesto printed in the programme of his play, "The Dance of Death," lately produced by the Group Theatre, makes himself appear a didactic and inaccurate literary snob.

Before I go on to make these harsh words good—to my own satisfaction at least—let me pause to explain that I have no prejudice, personal or artistic, against Mr. Auden. As it happens, I do not know any of his work except the manifesto in question. I did not see "The Dance of Death," have not read it, and, in fact, could not form an opinion of it at second-hand even if I thought second-hand opinions were worth forming. Moreover, I regard the Group Theatre as an admirable body of artists, who are trying to do something in our theatre of which it stands greatly in need. It is Mr. Auden's manifesto to which I object—the whole manifesto, and nothing but the manifesto.

Mr. Auden's Manifesto.

Let me therefore print the opusculum in full. Here it is:—

> Drama began as the act of a whole community. Ideally there would be no spectators. In practice every member of the audience should feel like an understudy.
>
> Drama is essentially an art of the body. The basis of acting is acrobatics, dancing, and all forms of physical skill. The music hall, the Christmas pantomime, and the country house charade are the most living drama of to-day.
>
> The development of the film has deprived drama of any excuse for being documentary. It is not in its nature to provide an ignorant and passive spectator with exciting news.
>
> The subject of drama on the other hand, is the commonly known, the universally familiar stories of the society or generation in which it is written. The audience, like the child listening to the fairy tale, ought to know what is going to happen next.
>
> Similarly the drama is not suited to the analysis of character which is the province of the novel. Dramatic characters are simplified, easily recognisable and over life-size.
>
> Dramatic speech should have the same confessed, significant, and undocumentary character, as dramatic movement.
>
> Drama in fact deals with the general and universal, not with the particular and local, but it is probable that drama can only deal, at any rate directly, with the relations of human beings with each other, not with the relation of man to the rest of nature.

Now, is Mr. Auden a literary snob, or is he merely blowing a fanfare to get himself noticed? In either case, the tone of his statement reeks of that false exclusiveness, that refusal to acknowledge the claims of anybody who cannot or will not master his particular shibboleth, which is the mark of the snob. The theatre is a wide field, and Mr. Auden is setting to work in a small corner of it. Let him cultivate his little garden by all means, and none of his fellow-workers will wish him anything but success. But when he looks over his fence, sneers at his fellow-workers, and accuses them of having produced nothing but a wilderness, he proves himself no true gardener.

A Question of Accuracy.

However, the question whether Mr. Auden *is* a pretentious person, or is merely making himself out, unconsciously or with a purpose, to seem so, is of no immediate importance. It can be left to the theatre itself to show whether he is genuine. The theatre is the house of pretence, but pretentiousness cannot live in it. The immediately important thing about Mr. Auden's manifesto is its inaccuracy.

Beginning as he means to go on, he makes his first sentence consist of a misstatement. "Drama," he says, "began as the act of a whole community." Well, unless Mr. Auden differs from the whole body of informed opinion on this subject, in which case he should say so and produce some sort of proof, he should know that drama did no such thing. It *arose out of* the act of a whole community, which is something quite different.

Mr. Auden probably has in mind the accepted belief that Greek tragedy derived from a religious dance-festival in honour of a god. The dance was the act of a whole community, and was performed under a priest. As time went on, the dance took a rudely dramatic form. The priest began to impersonate the god who was being worshipped, and passages of dialogue began to be spoken between him and the leader of the dancers. Much the same process saw the evolution of our own mystery-plays, out of church services in celebration of the Nativity.

Now surely it is clear that so long as the priest

remained a priest conducting a religious celebration, the ceremony remained the act of a whole community; but that as soon as the priest began to speak in a character other than his own, the band of celebrants began to lose its character as congregation and to take on the quality of an audience. Drama, therefore, came into being at the instant when somebody pretended to be somebody else. The basis of acting is impersonation, and not "acrobatics, dancing and all forms of physical skill." The dance-festival was not the seed of drama, as Mr. Auden has persuaded himself. It was the virgin soil in which the seed of drama was destined to be sown.

Abolishing the Audience.

Arguing with strict logic from his original false premises, Mr. Auden arrives quite naturally at a whole series of false conclusions. "Ideally there would be no spectators," he says. On the contrary, drama cannot exist without spectators. Impersonation, except in the nursery, presupposes spectators, and is undertaken originally for their benefit and ultimately for their approval.

"Drama is essentially an art of the body," he says. Naturally he must say so, since he derives it from a dance. And when he looks about him in the theatre for something to approve of, naturally he has to fix on the music-hall and the Christmas pantomime. Why he throws in the country house charade I cannot conceive. I suspect him here of pure affectation—that inverted form of highbrowism which takes a delight in being suddenly and provocatively low-brow, simply for publicity purposes. (There is a flippant part of my mind, by the way, which is finding it extremely difficult to take Mr. Auden seriously, or to believe that he really means any of this manifesto. This deplorable *alter ego* here suggests that the country house charade gives Mr. Auden the only practical example of his theory that ideally there would be no spectators. It is notorious that while these entertainments are great fun for the participants, they are apt to be slow torture for those who have to look on.)

Having defined what he wants the theatre to be, Mr. Auden then shows us the other side of the picture, and tells us what he wants it not to be. He begins with the question of the actual story with which drama should deal, and here I must confess that I do not find anything worth objecting to with any great heat. I think it is very arbitrary of him to limit himself to the "universally familiar stories"; and though I myself am too fond of going to the theatre to mind whether its stories are known to me beforehand or not, others of his spectators might not be so accommodating. And in regard to his remark that the audience, "like the child listening to the fairy tale, ought to know what is going to happen next," I should like to point out mildly, first, that the child likes the fairy-tale just as much the first time it hears it and, second, that after the first night of a new play the average spectator *does* know what is going to happen next, either from the newspapers or from his friends. I suspect Mr. Auden of having formulated this rule merely because the ancient Greeks had a similar limitation, and of having conveniently forgotten that the close connection of their drama with religion forced it on them. As for his remark about the theatre not being adapted to provide "exciting news," I can only guess vaguely at what he means, and hope he means something.

But when he begins to talk about character, he cuts straight at the heart of the theatre as I understand and believe in it. I must go carefully, however, because here I suspect Mr. Auden of another of his cheerful inaccuracies. His words are, "The drama is not suited to the analysis of character." Can he possibly mean exactly what he says? If he does, then, of course, I agree with him—but the statement is a truism so devastatingly obvious that it is wicked waste of ink and effort to write it down. Certainly, the drama is not suited to the analysis of character—but then, nobody in his senses has ever used, or would ever use, the drama for this purpose. I assume that Mr. Auden has used the word "analysis" carelessly, and that he really means something else. Analysis is a process of picking things to pieces. A dramatist in the act of writing a play cannot pick his characters to pieces; he is engaged in the opposite process of building them up. He is engaged in creating life; and the analyst cannot possibly begin his work till the act of creation is complete. Outside the world of ideas, of course, the analyst is concerned solely with things that are dead. You must be a corpse before you can hope to excite any professional interest in Sir Bernard Spilsbury.

The Type-Character.

What, then, does Mr. Auden mean here? The answer is to be found, I expect, in his remark that dramatic characters are "simplified, easily recognisable and over life-size," and his further dictum that drama deals with the general and universal, not with the particular and local. Translated into practical terms, this must mean that Mr. Auden does not think that dramatic characters should be individuals, but types or symbols.

If I misconstrue him here, I stand open to correction. But certainly in his own play the characters are not individuals. Few of them have names. They are described in the stage directions in general terms.

When they have names, those names are merely type-labels.

We have had a good deal of this kind of type-characterisation in recent years. At first it seemed fresh, exciting and full of promise; but as time went on it became merely tiresome, because, though it called itself expressionism, it was in fact a fetter on expression. As soon as the experimenters in this field had carried out the process of simplification, they found themselves with no ideas to express, and no stories to tell.

It is a trite remark that there are very few basic plots in the world; and as a plot is the expression of an idea, it follows that there are not many ideas either. An artist achieves originality not by finding new plots or new ideas, but by discovering new aspects of those which perennially exist. A dramatist, dealing with stories about "the relations of human beings with each other" (Mr. Auden's words), finds scope for his originality, which is another way of saying his approach to universality, not by trying to add to the fixed and constant collection of plots or ideas, but in expressing the infinite variation of human character. Therefore, I hold firmly that a dramatist's greatness consists, first and foremost, in his ability to understand, interpret, and create individual character.

Why, for instance, is Shakespeare a better dramatist than Marlowe? Simply because he had a better grasp than Marlowe of the particular and local, with the result that his people live and Marlowe's do not. As poets the two men stand almost equal. Judged by Mr. Auden's test, Marlowe is obviously the greater, for the people of his plays are "simplified, easily recognisable and over life size" to a degree which Shakespeare never attained—or was wise enough to avoid.

It chances that, as I write these words, the last play I have seen is Chekov's "The Three Sisters." There could hardly be a play which corresponded less well with Mr. Auden's demands, for its action and characters are as particular and local as can be; yet there never was a play which brought the sense of universality more clearly before one's mind.

The Death of Action.

The fact is, that as soon as a dramatist aims directly at the general and universal he loses it. He invents the character, say, of A Gentleman in a Top Hat. Instantly he finds that all he can give his character to say or do is that small range of speech or action which is common to all gentlemen in top hats. In fact, the best reason for creating such a character at all is that it enables him to make the satirical point that all gentlemen in top hats say and do much the same sort of thing. The dramatist who creates an individual gentleman in a top hat gives himself more freedom. Like Maugham in "The Breadwinner," he can make him jump on his hat as an individual protest; or like Barrie in "Peter Pan," he can make him live in a dog kennel as an individual penance. Mr. Auden's kind of author cannot do these things without committing himself to a statement that all men of the professional classes jump on their hats or live in dog kennels.

We had a sharp reminder the other day, when "The Hangman" was produced, how cramped and sterile is this particular corner of the dramatic field. So long as this play dealt with the mediæval legend of the hangman it had some life and colour, because a certain amount of individual characterisation had crept into the writing. But when the second half of the play began, with the Hangman symbolically brooding over a modern night-club, which stood for the Europe of to-day, all life and colour vanished, together with all sense of originality.

The "Night-Club" Distortion.

Almost every author who sits down to write in this particular idiom seems forced, when he wants a symbol for modern civilisation, to find it in a night-club, a music-hall, or a circus; and when he wants a symbol for womanhood, he finds it as invariably in the prostitute. The result is that there is almost nothing that he can say either about civilisation or about woman. "Maya" is the best of these prostitute-symbol plays. It is quite a good play; but it never touches greatness, because Maya herself is less an individual woman than a figure standing inadequately for Womanhood.

That there is a place for symbolism in the theatre, and an important place, I should be the last to deny. Only, it must be subordinate to character. The ancient Greek tragedians knew this. So did such a master of the theatre as Ibsen. Consider how the symbolism of "The Master Builder," though subordinate to its characterisation, is used to raise the characters of the play to a higher order of magnitude. Unless Halvard Solness and Hilda Wangel are thought of as being symbolic figures, "The Master Builder" dwindles to a tiresome tale of a silly old man who tried to please a ridiculous enthusiast of a girl by climbing about on towers when he had no head for heights; and how, as was only to be expected, he fell off. The play is much more than that because Ibsen, while using Solness and Hilda to convey his sense of universality, still made them individuals with a life of their own.

The theatre is, however, a place where an ounce of practice is worth a ton of theory. If Mr. Auden can write better than he argues, he may find his feet and his following. If not, he will at least have the satisfaction of realising his ideal, that there should be no spectators.

Dust: its Meaning for Mankind.

By S. C. Blacktin, Ph.D., M.Sc.

Dr. Blacktin, by his exhaustive studies and previous publications, has made the subject of Dust his own. We are glad to be able to offer our readers his summary of this great, if at first sight unattractive subject; for not only are observed facts revealed, but also possibilities of further productive research are suggested.

It is unusual to read through a book of any length without finding some reference to dust. Not only does this apply to modern literature, but to books of all eras. As a book that presents all phases of human life and experience, the Bible necessarily contains many remarks on dust. Homer makes constant reference to dust in his "Iliad." References to dust are more numerous in literature dealing with eastern climes, or dry, sterile districts such as Colorado and Utah, and, in books whose scenes are completely encompassed in cities, east-end descriptions are likely to afford more references to dust than west-end ones. In almost all accounts of the slower, older modes of travel dust claims a considerable part, yet also in more modern accounts of travel or exploit—whether long-distance flight or attempts to scale Everest—dust enters appreciably into consideration. Such progressive spheres do not, however, exhaust the references to dust, for it becomes the focus of some of the direst and most destructive topical events—witness, for example the vast dust storms in America.

It is in keeping with the general human attitude to the subject of dust, that of all the above references to the subject, the majority will use it to indicate an actual nuisance, inconvenience, or scourge, or as a figure of speech for opprobrium, degradation, decay, or departure from desirable standards.

A Neglected Study

Amongst all the vast natural systems which are as universal as Space or as old as Time, dust seems to be the one great common scapegoat. This is strange if only because dust is one of such vast natural systems. Strange, because despite the scope and magnitude of dust, the presiding genius of the scientific spirit—which impels men to seek and study all objects and phenomena in the sea, on the earth, or over it—should have all but ignored a field of such high potential interest. Of a generality equal to that of water or air, is dust. And if the economy of Nature is an ideal economy, can it not be concluded that, of similar generality, dust will be of similar importance, to water and air? Why then has it been so long ignored and despised and allowed but a grudging and forced acknowledgment as something to be sedulously avoided? There may be several reasons. First, the relationship of dust to human life is not so direct, immediate, or obvious, as the relationship of water or air. Men cherish water or air because they know they cannot survive without them. They study them. They do not cherish dust because they do not yet know that their water would not fall as rain without dust nuclei for the drops; that their air might be as the breath of a furnace were it not charged with dust. Therefore, they do not study dust. A second reason for despising dust—perhaps the reason which encourages the above neglect—is that its immediate action on human beings is annoying; its appearance is not, generally, attractive; and it suggests an unpleasant forecast to the subjective imagination regarding the personality itself.

Origins of Dust

We are so familiar with the ever-abiding presence of dust that, taking it for granted, we seldom inquire whence it comes. It has various sources whose most common factor seems to be that they form dusts through their own disintegration. The skies above us are one of the most constant suppliers of dust. For through the skies meteors and meteorites are gravitationally drawn towards the Earth. Practically none of the small meteors reach it, but a few large meteorites do—say about ten per annum. So that of the 20,000,000 meteors (Sir N. Lockyer's estimate was about 400,000,000) which enter our atmosphere each day, practically all are disintegrated by friction to dust. This is a huge number, but the average weight may be less than one-hundredth of a gram. So that although the meteors do not reach the earth whilst the dust they form eventually largely does so, they may add only about 100,000 gm. of dust per day, or perhaps enough to make a layer all over the earth about one millimetre deep in 40 million years. This does not seem much, but it is not the only sky source of dust. Volcanic eruptions are constantly shooting dust high into the air, a large proportion of which sooner or later settles on the earth.

The classical example of this is the Krakatoan eruption of 1883 which reached a height of 17 miles and produced artificial night 150 miles around. This vast dust ejection was formed from the disintegration of the island of Krakatoa, and since much of the dust passed three or more times round the earth before settling, it is not

surprising that ships 1,600 miles away received deep dust deposits on their decks even three days after the eruption. What is not so well known as this is that successive eruptions about 1927 have re-built, then re-destroyed a Krakatoan *anak* (child) island several times. Together with noxious gases, the terrible dust emission from Mont Pelée in Martinique, destroyed 30,000 people in a few minutes. At first red hot, the dust was still falling several days afterwards whilst about two months later a further emission covered the whole of the West Indies with white ash. Details and data of such vast, volcanic, dust additions to the atmosphere are given in the author's book.* In addition to such dust additions from the skies which, whilst not obviously beneficial, are often obviously dangerous and death-dealing, there is a constant beneficial addition therefrom which is a necessity of existence, and which, though often regarded as a nuisance is fervently desired if for long absent. This is the dust brought down by rain. Raindrops will themselves sweep much dust from the air to the earth, but it is rather the dust particles which are necessary to the formation of the drops which are now considered. Thus, while it is true that, under certain conditions of moisture saturation, raindrops may form on sub-molecular electrically-charged units, or ions, in general a solid particle nucleus is required on which vapour in the atmosphere may begin and continue to condense as water. If these nuclei are sufficiently soluble they will, by solution in the drop which forms on them, be probably prevented from reaching the earth as dust particles. But, whenever nuclei are insoluble, after the drop reaches the earth and either flows away or vaporises, they are left as units in the continuing addition of dust to the earth. It requires little imagination to realise that the dust addition through rain must be considerable.

The above may be regarded as the three chief modes of dust addition from the skies. It ought to be realised that such additions have probably been continuing since the Earth's formation and have therefore had time to form a substantial part of the vast accumulations which everywhere confront us, despite persistent removal. Other sources of dust lie on the earth's surface itself. They are (1) the disintegration and erosion which all objects undergo, and (2) the effects of operations performed by man. Respectively, therefore, they operate through natural and human agency, but ultimately they are put into motion by the same agency—the Sun. This may at first seem obscure, but will no longer when it is realised that the sun is the source of (*a*) the heat and water (rain) whose conjoint variations cause degradation and erosion, and (*b*) of the fuel upon which man indispensably relies to carry out his dust-making processes. Eventually, therefore, dust-forming operations on the earth also originate in the skies.

Photo by the Houston-Mount Everest Flight. [*By courtesy of Messrs. Chapman and Hall Ltd.*

The Earth's highest dust-cloud, the ice-plume, several miles long, blowing off the summit of Everest. It is about $13\frac{3}{4}$ *miles above the Earth's lowest possible dust deposit* (44,000 *ft. at Nares Deep*).

Little space need be taken in emphasising the immense extent of these earth sources of dust. In Nature, dust formation is continual and rapid with a maximum rate where temperature range is a maximum. In different parts of the earth rocks are eaten away until the often-

* *Dust.* By S. C. BLACKTIN. (Chapman & Hall, 18s.)

resultant rock-pillars, eventually eroded right through, precipitate their summits. Geology tells a complete story of the widespread weathering which proceeds, but cannot easily trace the whereabouts of the resultant dust. In the operations which men have performed from age to age, the dust addition has varied. But it attained, quite rapidly, unusually large dimensions from the inception of the Industrial Revolution based on the introduction, in England, of iron and coal. As the cradle of these raw materials of industrial advance, Great Britain—with the probable exception of certain districts of the United States and Germany—still produces most industrial dust. Some notion of its extent may be realised when it is suggested that one year may see an industrial dust addition about equal to the cosmic meteoric addition of 50 million years. It should be added that just as dust already suspended in the air helps degradation in Nature by operating as a frictional agent, so industrial dusts assist degradation by destroying the fabric of buildings, etc. As such frictional forces require the driving force of wind, they introduce the consideration of the earth-wide operation of the wind systems as a vast driving force for mixing dusts from various sources ; spreading them ; and using them as a ceaseless grinding agent in the formation of further geological dust. Moreover, the transference of huge dust loads from location to location under the winds' driving force accounts for the sandstorms of the deserts ; the cyclonic dust storms over vast regions of America, or the small, local ones of the English summer ; huge formations like the Chinese loess blown from the Gobi desert ; the Harmattan haze of Northern Africa ; the " dust devils " of the east ; and, indirectly, " blood " rains, and yellow snows. Effects due to such large dust storms have been discussed in *Discovery* (Dr. L. Dudley Stamp, Aug. 1935, pp. 219-224), while in 1863 6,500,000 tons of dust fell in the Canary Islands, and several million tons fell over areas of 100,000 square miles in Europe and Africa in 1901. What might be called the " long-term " effect of the driving wind is seen in the actions of sand dunes, which have often buried forests, churches, and complete towns. The method of arresting their insidious devouring action is similar to that of avoiding the huge American dust storms of recent years, viz., the growing of grasses or trees to arrest the continuity of their march.

Dust the Ubiquitous.

The great extent of steady dust accumulations over the earth from the above sources can be realised from a moment's thought. And this reveals that the vast quantities of which the temperate zones experience probably but a modicum—though so very real and annoying—are, after all, only the remnants after large removals from the more usual pathways of mankind. So that the inquiry : " Where does dust go to ? " refers to that portion only which is not always here to trouble us. That which does not constantly grime us ; provide steady work in its removal from our houses ; blacken our lungs and our city vegetation ; turn bright colours drab ; impair our atmospheric visibility ; fill our food, in sandy places, with grit ; and suffocate and blind us when the wind appreciably rises.

The Founder of Civilisations.

There are two chief means of removal, and they have one characteristic in common. This is that after removing the dust, they assist in storing it up to be again set free through one of the supply sources already discussed. Thus, of that large quantity which is removed to the seas and oceans in water currents, some proportion will probably form sedimentary rock. In this connection it may be mentioned that salt sea water often acts as a coagulant of colloid systems consisting of fine particles dispersed in fresh water. In this way large areas have been built up from silt in their deltas, by such long rivers as the Mississippi. Of course, much of this silt is directly derived from soil without the intermediate stage of dust formation. But the real distinction is that the particles are dispersed in water straightway, instead of in air as a preliminary. The cardinal fact is dispersion from solid masses into separate particles, whether the supporting medium be air or water. In any case, this building-up of land areas in deltas is a comforting fact to offset that other dust production, caused by coast erosion, which is becoming so serious in some districts of Great Britain. The mighty modern civilisations which, in a material sense, have been made possible only by the iron and coal economy, had their birth in the Industrial Revolution in Britain. The industrial areas of Britain which are, therefore, the heart of these civilisations, are chiefly spread out over a foundation of sedimentary deposits. Dust of bygone ages, therefore, probably played an important part in providing the geological foundations for modern civilisation. Is dust, in one aspect of its removal to form sedimentary structures, gradually setting the stage for repetition of some such advance in some totally different locality, in some future era ?

The question of both the sources and goals of dust is a question of redistribution over the earth—with the exception of meteor dust, and any possible escape from the atmosphere through the stratosphere into space. Of this redistribution the most interesting and effective is the removal of dust by the wind systems. This mode of removal is world-wide ; it is that mode of removal

which most compels people to recognise the extent and persistence of dust ; it mixes all the various kinds of dust, whether of modern, historic, or prehistoric formation, whether meteoric or earth-formed ; it transports deserts and keeps dunes moving ; it can create fertile loesses supporting the life of millions ; it may ruin agriculture and bury cities ; it mixes industrial dusts from western countries with siliceous dusts from eastern climes ; it forms the basis of a constant supply of nuclei for rain-drop formation throughout the earth ; and it accounts for the " blood " rain, " black " rain, and yellow snow. On the supposition that *most* rain is formed on dust nuclei, the heavy rainfalls of monsoon and tropical regions suggest that more dust is blown to the atmosphere in equatorial regions than is retained in temperate zones. And this coincides with the known wind-systems, which, near the earth, converge towards the equator. Not least among the effects of wind circulation on dust is that it ensures the latter's existence in all regions of the earth, on the earth's surface. Whether the Dutch town of Alkmaar erects shelters to guard its cheeses from dust ; the Abyssinian buries his forehead in it as the Emperor passes ; or the Indian achieves virtue by eating it ; dust is universal.

Industrial Uses of Dust.

It may be at once stated that dust was indispensably useful in founding, millions of years ago, our present civilisation. This may seem highly exaggerated. But dust is necessary for rain ; rain is essential for tree and plant growth ; and tree and plant growth was essential to provide the raw material for coal formation. And only if modern civilisations are *not* reared on coal as raw material, is this importance of dust untrue. Incidentally, several million tons of this coal contaminate our atmosphere each year, as dust or smoke. So that our polluted atmosphere can thus be traced to the existence of prehistoric dust. Prehistoric dust is the actual ancestor of that which we now breathe. But if dust has no more important use than this, it certainly has much more modern uses ; everyday and quickly increasing uses whose importance cannot be overemphasised. Modern uses are nearly all dependent on one scientific fact : that breaking solid bodies down into dust increases the relative surface area. Now, all physical and chemical action must operate across surfaces, for contact between different objects and materials only occurs across surfaces—even if so small as molecular, and even if the surfaces are separated. And this is especially so with regard to such operations as grinding, burning (i.e., rapid oxidation) or where other rapid chemical action is required. Thus, reduction to dust speeds up certain vital actions on which important operations depend, and introduces conveniences in working which are demanded by modern machinery. Thus no internal combustion engine for motor propulsion could burn raw lump coal instead of petrol, but experiments are now well-advanced in which coal dust replaces petrol as fuel in such engines. Also the economies often gained by burning oil through jets in much modern boiler-heating practice might be considered as extended if solid fuel could be added to the oil. Such solid fuel would first have to be reduced to dust, and a year or two ago the S.S. *Scythia* crossed the Atlantic on such a fuel mixture of coal dust and oil. Numerous laboratory operations are accelerated because the pestle and mortar, or power-driven grinding unit, to reduce reagents towards dust form as a preliminary, are a permanent laboratory feature. Vast industries (e.g., the paint industry) absolutely depend on the prior reduction of solid materials to dust in different forms. Other huge industries, such as sulphuric-acid manufacture, require powdered catalysts for employing the Contact process.

A Study of Real Value.

It can be truthfully stated that, just as dust millions of years ago was essential to the production of our present coal power, even now is it every day essential to the production of other basic materials without which much of our coal power would remain unutilised and useless.

So far, the study of dusts may be said to have proceeded in two main directions : (1) investigation of the dangerous effects or hazards to which dusts are likely to give rise ; and (2) the study of methods for measuring the particle frequency and particle size of dusts. Such questions, for example, have been studied as the conditions of accidents in factories, mills, and mines due to explosion of dusty atmospheres ; or the physiological danger of many dusty industrial operations—chief among which is the liability to silicosis. Such problems have excited much Government attention, and continue to do so in an increasing degree.[1] W. E. Gibbs[2] has studied such dangers, as also the author in his book *Dust*, and, in America, Price, Brown, Brown and Roethe.[3] Following earlier work by W. A. D. Rudge, the author's researches have shown that the most insidious cause of explosion is likely to be that due to electrical sparking, for such work revealed that the electricity spontaneously generated by whirling dust will promote sparks of sufficient energy to ignite inflammable gases.[4]

In the second branch of study the first instrument for

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[1] See *The Chemical Age*, Aug. 23rd, 1935.
[2] *The Dust Hazard in Industry* (Benn).
[3] *Dust Explosions* (Nat. Fire Protection Assoc., Boston).
[4] *Electricity and Dust :* by S. C. Blacktin, " The Electrical Review," pp. 85-86, Jan. 18th, 1935.

estimating the number of dust particles in a given sample of air seems to have been invented by J. Aitken. Its principle was the sudden cooling of the air (containing the particles) whose moisture was, therefore, condensed on the particles as nuclei. The counting of the drops was equivalent to the counting of the particles. J. S. Owens later developed a hand-operated instrument—the jet dust-counter—which used the same principle, and also advanced a dry method of dust settlement. Sir R. N. Kotze in South Africa developed a "konimeter" which impinges the particles on to a disc where they can be counted, and Messrs. Zeiss have also independently produced a konimeter. In the United States, the Greenburg-Smith Impinger is much used, and numerous other mechanical methods referred to in *Dust* have been put forward from time to time. Optical methods also have been used, and amongst these the photoelectric photometer gives best promise of estimating dust concentrations, and the ultramicroscope of counting particles. A thermal method by which the particles are driven selectively on to a relatively cold plate has also been developed. The electrostatic precipitation method of depositing suspended dust, studied independently by Sir Oliver Lodge in Britain, Erwin Möller in Germany, and F. G. Cottrell in the United States, whose results have been commercially combined with the object of making great economies in valuable materials, was first applied in the United States by P. Drinker as a means of precipitating dust particles on to celluloid sheets for counting. As regards the commercial aspect, other mechanical methods have been developed for depositing dust from gases, so that electrostatic precipitation does not completely nold the field. Many of these different estimation processes give different results for the dust content of similar samples of gas or air, so that it is, at present, difficult to know whether the real particle number is as large as that shown by the Aitken counter, or as small as that given by the Owens jet dust-counter and thermal methods. What is definitely known and is of great importance is that dust particles permeate the air wherever samples have been taken, not excluding the relatively pure air of mid-ocean and mountain peak. And it is the pioneering work of J. S. Owens with his own instruments, which has to a great extent made this conclusion possible, though there were also earlier pioneers.

Atmospheric Marvels.

Against the background of its persistent neglect, the study of dust becomes a succession of marvels. At the same time some specific aspects are of quite entrancing interest, even when dust is regarded as a normal study. Thus, the range and diversity of colours which the sky presents, especially at sunrise or sunset—most remarkably after some volcanic dust eruptions—is due to dust dispersed throughout the atmosphere. Not less marvellous is it that dust protects us from the severest atmospheric contrasts of heat and cold. The ubiquity of dust is something to wonder about! *Distilled* water contains 20,000 motes per cubic centimetre. The illuminated dust specks in sunbeams showed Tyndal, that that which makes seeing possible—Light—is itself invisible. If the sun's light were not continuously scattered by dust particles, the sky would seem perpetually dark. In desert sandstorms, the electrical charge produced on an insulated object—say, a motor car—will produce dangerous sparks over a foot long. Snow dust generates electricity, and the highest point on the earth's surface—Everest summit—is graced by a miles-long plume, largely composed of snow dust.

But probably the greatest marvel of all about dust is that, although our lives are completely surrounded and interpenetrated by a dust atmosphere—the Staubosphere—throughout their length; although we never take a breath of air that does not contain dust; although our material end is dust, and dust tracks and precedes our every step—literally and metaphorically—the only time we are apt to recognise its presence is when it makes a film on our footwear, becomes distinctly visible to the naked eye, or actually importunes our ease of breathing.

Industrial Dangers Revealed.

Londoners are notoriously ignorant of the sights and attractions of their city; and of all the museums that they neglect, surely none is surpassed in this respect by the Home Office Industrial Museum, in Horseferry Road, Westminster. Yet everyone engaged in any sort of industry, whether as employer or employed, will find something there which will interest him vitally; and it is not too much to say that a visit may mean the difference between life and death. Dr. Blacktin, in the preceding article, has called attention to the hazards of industrial dust: a series of exhibits in the Museum illustrates the gruesome effects of silicosis and shows approved methods of combating it. But this is only one type of the multiple kinds of danger to which industrial workers are exposed, and Mr. Leonard Ward, O.B.E., in the Shaw Lecture delivered to the Royal Society of Arts (published in their *Journal*, November 1st, 1935), gave some illuminating statistics on factory accidents, all sorts of which are dealt with in London's loneliest museum.

New Light on Early Man in America.

By E. N. Fallaize.

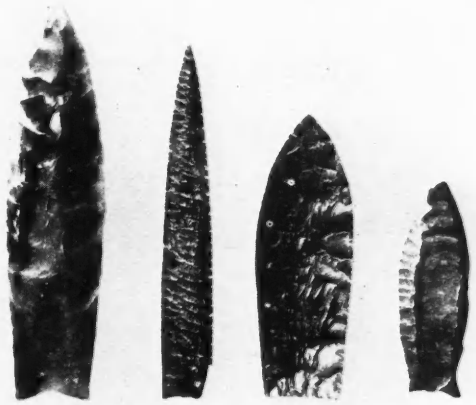
American anthropologists are to be envied, so extensive is the field of research lying before them. New discoveries here detailed seem to place the dating of the arrival of man in America almost within reach, but the verdict still awaits a final examination of the confusing evidence.

In 1922 there appeared in Discovery (II; 265, 294), under the title *The Antiquity of Man in America*, a review of the evidence in the form of finds of human skeletal material, reported to be fossil, upon which had been based a claim for the high antiquity of man on the American continent. It was then shown that it was not possible to maintain that any of these skeletal remains, whether from North or from South America, represented an early or extinct type of man, nor that the geological conditions in which they were found placed beyond question the contention that man had reached the American continent by, or had existed there during, the Ice Age.* This conclusion was in agreement with the view which, on the whole, has dominated the field in the study of prehistoric anthropology in America during the greater part of the present century. On that view it was held that an antiquity of not more than, say, six to eight thousand years could be conceded to man in America and that at the time of his coming he had in all probability already attained a neolithic stage of cultural development.

This view has been challenged on several occasions in the last decade; and within the last five or six years a series of discoveries in archæological and palæontological investigations in the south-western United States has weakened the confident negation of claims for the existence of man in North America in, at least, the closing phases of the quaternary geological epoch.

There is still, however, no evidence for the physical type of the man who produced what is now claimed to be the earliest Stone Age culture of America. Of the more recent finds, the geological age of the human skeleton found at Pelican Rapids, Minnesota, in the silt deposits in front of the Wisconsin ice sheet, belonging to the last phase of the American Ice Age, is disputed on the ground that the silts have been disturbed by landslide; and the recently discovered fragment of a human cranium from Nebraska, thought by some to be of Neanderthal type, has now been shown to be characteristically "modern" and Indian, notwithstanding the unusually high development of the eyebrow ridges, which were taken to warrant its classification as Neanderthaloid.

One of the most serious difficulties with which the anthropologist is confronted in marshalling the evidence in support of the antiquity of his finds is the interpretation of the geological data, owing to the still imperfect knowledge of American quaternary geology. This is well illustrated by the discoveries at Frederick, Oklahoma, one of the most hotly debated problems of recent years in American archæology. Here the evidence for the presence of man in quaternary times has been disputed with little advance towards finality, the only point on which agreement has been reached being that there is need for further investigation.



Artefacts of the Folsom type, showing the high standard of craftsmanship attained. The second from the left is an example of Professor Renaud's "Yuma" points.

It may not be out of place to recall here the limitations within which the archæologist in America must work. It is commonly argued, though not universally agreed, that during quaternary times conditions in North America were much the same as in Europe and Asia, and that the northern part of the continent was covered with an ice cap, which was affected by periods of maximum glaciation and interglacial phases in which milder conditions prevailed. It is clear that man, coming, as

* Professor P. Rivet, of Paris, and Professor J. L. Myres, in the *Cambridge Ancient History*, Vol. I, have since inclined to acceptance of the Lagoa Santa group (California, Brazil, Patagonia), as representing an early type, which reached America, Professor Rivet holds, across the southern Pacific; but Dr. A. Hrdlička has shown that the arguments in favour of these views have no foundation.

seems most probable, by the Bering Straits route, could have reached the American continent only in conditions moderately favourable to his transit. This would seem to restrict the possibility of entry at the earliest to one of the minor oscillations at the close of the Ice Age or to the period of transition which followed immediately on the close of the Pleistocene. This, at least, was the view held until recently, not merely by opponents, but even by those who were prepared to accept the evidence for quaternary man in America.

While there is nothing inherently impossible in the view that man might have reached America during one of the warmer interglacial periods, earlier in the quaternary epoch, the fact that no early or extinct type of man, but only "modern" man, is known to have existed on the continent, argues that he reached its shores at a late phase of his development, i.e., after "modern" man had appeared in the Old World—an event usually assigned to Upper Palæolithic times, when Crô Magnon man comes on the scene. An element of uncertainty, however, is now introduced by recent argument for a much earlier dating of "modern" man in the Old World which opens wider the door in the examination of the American evidence.

An attempt has been made to classify the stone implements of the south-western States according to the cultural sequence of European archæology, and Acheulean, Mousterian, Aurignacian, and even a qualified Solutrean, have been recognised. Apart from the growing doubt as to the propriety of applying a European classification to non-European cultures, the American resemblances are not absolute and, in any case, can carry no implication as to date. As is well known, primitive types of implements may be found in advanced cultures, while such little positive evidence of dating as does exist in America seems to contradict the argument from typology.

Such then, in general terms, are the considerations taken into account in assigning a late date to the entry of man in America. We may now turn to the discoveries of the last ten years, upon which a number of distinguished archæologists take their stand in claiming that the period of man's habitation on the continent must now be extended to twelve, fifteen, or, some would go so far as to say, twenty thousand years.

The Folsom Culture.

The new evidence which has been brought to light centres mainly around three issues:—the antiquity of the Folsom stone industry, or as it is now legitimate to say, Folsom culture, and its relation to other types of the Stone Age culture of America; the association of artefacts with the remains of an extinct fauna; and the chronological implications of the correlation of culture with evidence of climatic variation.

The Folsom "point" was first recognised as a distinctive type in the American Stone Age culture in 1927 at Folsom, New Mexico, where in the preceding year ancient bone beds, discovered on the upper reaches of the Cimarron River in 1925, had yielded indications of the association of man with the remains of an extinct fauna. A series of investigations, lasting over a number of seasons, carried out by the Colorado Museum of Natural History and the American Museum of Natural History of New York jointly, confirmed these indications, the most important single piece of evidence being a Folsom point which was discovered between two bones of an extinct form of bison. This specimen, which was seen *in situ* by several archæologists of unquestionable standing, is now exhibited intact in its original matrix in the Colorado Museum.

From Canada to Mexico.

Subsequent discoveries have shown that the Folsom point has a wide distribution, extending over New Mexico, Texas, Colorado, Nebraska, Kansas, and Wyoming. It has also been pointed out that it had been known since 1897, though its significance had escaped notice, owing to the fact that it had occurred only in surface finds; and further that it has a distribution extending from Canada to the Gulf of Mexico and from the Rockies to the Atlantic.

This wider distribution, however, as a result of further study, cannot be accepted. The Folsom point is a distinctive type, in which the most marked characteristic is that in these leaf-shaped implements, usually having a semi-circular notch at the base, a longitudinal groove on both faces leaves a ridge running parallel to each edge and gives the implement in section the form of a double concave. In this characteristic form it has been found up to the present only in the states mentioned above, and it is confined to the "high lands" east of the Rockies. Its relation, chronological and typological, to other forms of point at present is obscure; but the more generalised form appears to belong to centres of distribution further east. Professor E. B. Renaud, of the University of Denver, differentiates within the Folsom group a Yuma point which he regards as typologically and chronologically earlier; but his examples are from surface finds, and such inferences as to chronology which are possible appear to be against his view.

The existence of a specific Folsom culture, previously assumed, has now been established by the discovery of the Lindenmeier habitation and factory site in Colorado, partially excavated in 1934 by Mr. F. H. H.

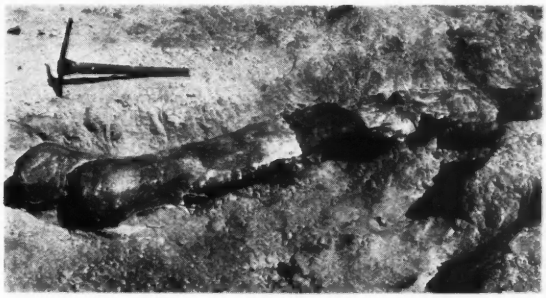
Roberts, Jr., of the Bureau of American Ethnology. The cultural complex is that of a hunting people, closely associated with the bison, including the extinct form. Judging from the character of the implements, especially the number and variety of scrapers, a free use was made of skins. The stratigraphical conditions of the site, and its relation to neighbouring fluviatile deposits, make it probable that when it has been fully explored, it will afford further light on the dating of the Folsom culture. The latest investigations have (1935) produced a Folsom point embedded in the vertebra of an extinct bison.

As already mentioned, the artefacts found at Folsom were associated with two extinct forms of bison: and this association with the bison appears in later finds in New Mexico, Texas, Colorado, and Nebraska. Even more significant are discoveries in Colorado and Nebraska, in which the Folsom point appears with the remains of other mammals, such as, for example, that at Dent, Colorado (1932-1933), in which the remains of twelve young mammoths were in association with two stone points, of which one had the characteristic longitudinal groove, or that at Angus, Nebraska, in which a crudely chipped grooved point is said to have been found with the remains of a mammoth. Of these the find at Angus would be the most important, had it expert corroboration, as it is possible that it may belong to an interglacial period.

Man and Mammoth.

Systematic investigations in New Mexico by Mr. E. B. Howard, of the University of Pennsylvania, in 1930-1934, have produced evidence from the caves of the Guadalupe Mountains and from lake beds near Clovis of the contemporaneous existence of man and an extinct fauna, mammoth, bison, etc. The most significant association, however, is that of a Folsom point with a species of musk-ox. This animal is held to be incontrovertible evidence of a cold climate. Incidentally, it may be mentioned in passing, stratified evidence placed it beyond question that the Folsom culture was older than the culture of the Basket Makers, hitherto regarded as the oldest known culture, as such, in the south-west. Traces of the use of fire were also found.

This body of evidence, accruing since 1929, of which that collected by Mr. Howard, whose conclusions are accepted by Sir. A. Smith-Woodward, is the most important, carries considerable weight. In European archæology, an incontestable association of implements, of which the human origin could not be questioned, with an extinct quaternary fauna would be accepted as sufficient evidence for the presence of quaternary man. Unfortunately,



Leg-bone of an extinct elephant, found in New Mexico in association with Folsom type points.

in America matters stand otherwise; and what would appear the logical conclusion is disputed, mainly on two grounds. In the first place it is argued that in many instances, including some of the finds in New Mexico, the association is fortuitous. These are the finds from "blow outs," i.e., dried up water holes, from which the wind has eroded the sands, leaving artefacts and animal bones at the bottom in an association which, it is maintained, does not represent their true relation in the original stratification of deposits. Secondly, it is held by geologists and palæontologists of authority that the extinct fauna of America did not vanish at the close of the quaternary age, but survived into "recent" times and down to the relatively late period when man appeared on the scene. Obviously it is difficult to meet either of these objections. The refutation of the first contention throws a heavy onus on the acumen and experience of the observer; while the second, in its application to those instances in which the association is beyond question, demands a much clearer understanding of the quaternary geology of America than is available at present before any final verdict is possible.

The Most Important Discovery.

The effect of the ambiguity of interpretation of deposits claimed as quaternary is well illustrated in an attempt to establish the chronology by climatic variation of what must be regarded as one of the most important of recent discoveries in the stone age archæology of America. This is a site at Signal Butte, Nebraska, which was excavated by Dr. W. Duncan Strong in 1932. Here, in a mound, was found stratified evidence of three periods of occupation, each separated by wind-borne sands deposited over considerable periods, and in which the earliest occupation rested on sands claimed to be water-borne, and of pleistocene age. Some authorities, however, regard the sands below the first occupation as also wind-borne and not of pleistocene date, thus reducing the chronological estimate, if this

be accepted, by something like two thousand years.

It is not possible here to enter into the evidence on which the stratification at Signal Butte has been correlated with climatic variation in North America as a basis of chronology. Broadly speaking, the periods of human occupation are held to coincide with periods of humidity and the æolian deposits with periods of aridity. On this basis the first occupation is assigned an antiquity of approximately 10,000 years, the second occupation 5,000 years, and the third not more than 1,000 years. This last is entirely prehistoric (in the American sense, i.e., pre-Columbian) and is the only occupation of the three in which pottery appears.

This site is the only one as yet discovered in America in which it is possible to follow the development of culture, and of the types of stone implements in an exact chronological sequence determined by stratigraphy. In regard to its bearing on the age of the Folsom industry, at present all that it is possible to say is that while Signal Butte is related to the culture of the Lindenmeier site it is considerably later in date. At least one other site intervenes, chronologically and culturally. The sequence does not appear to bear out the argument for the priority of the Yuma point.

If then, the chronological argument from the correlation with climatic variation can be shown by further investigation to hold good, the Folsom culture would appear not only to be the earliest known in America, but also to be more than ten thousand years old. That so highly specialised a form as the Folsom point should appear at the beginning of the cultural sequence obviously raises questions which must await consideration until its relation to other forms, now under examination, is better understood.

Conflicting Arguments.

Many lines of research in anthropology, such as, for example, the distribution of blood groups, or the occurrence of certain physical characters pointing to a primitive strain in the indigenous population of the Americas, lead to hypotheses which would be readier of acceptance could it be shown that man had reached America at an early stage in his history. On the other hand, the arguments against such an early appearance are strong, and concrete evidences in its support, though gaining weight, by no means have attained the stage of conviction as yet. The position bears a certain resemblance to that of the dating of early man in East Africa: in America, as in Kenya and Tanganyika, it would appear as though we must be content for a while, until further information accrues, to hold the question in suspense.

The March of Knowledge.

New Film Screen A demonstration of a new film screen, known as Bulman Stereotone Glass Screen, was given at the Polytechnic Theatre recently. This screen is made up of a multitude of tiny glass globules, and it is claimed that the occupants of seats either right in the front of the theatre or at the extreme sides of it will not suffer from the feeling that the film is distorted. The demonstration proved the claim of the new screen fairly satisfactorily and it should certainly add to the comfort of badly-placed spectators.

Safety for Radio Workers. An ingenious "tell-tale" device, to be carried in the pocket of radiotherapy operators, has been evolved, by the physicist of the Westminster Hospital annexe, from principles previously worked out by research men in Sweden. It consists of a small tube containing a highly insulated rod of elektron charged to about 400 V., which charge is caused to leak off owing to the effects of the radium encountered by the operator in his work. Measurement of the amount of leak will afford a check on the amount of exposure which any worker has received, and a simple timing device will indicate whether this approaches the danger-level.

Invader of British Rivers. At a recent meeting of the London Zoological Society, Professor R. T. Leiper exhibited a specimen of the Mittened Crab (*Erioheir sinensis*), which had been dredged up off Battersea Power Station, and was the first to have been found in England. This Chinese species (as reported in *Nature* recently) has lately invaded European rivers and has undermined their banks to a certain extent. The damage it thus causes, however, is in no way comparable to that caused by the musk-rat; more serious are its depredations among freshwater fish, and it will be interesting to note what effect it has on local angling.

Fuel and Refrigerator. A combination fuel-refrigeration system for food lorries is outlined in the *Journal of the Franklin Institute* (October, 1935). In such an arrangement propane, a gas at ordinary temperatures, cools the lorry body and takes the place of petrol. Propane is closely related chemically to petrol, being classed as one of the lower paraffin hydrocarbons, while petrol, a volatile liquid, is composed of paraffins more complicated in structure. As a matter of economy, propane is supplied in its liquid form in

pressure cylinders that are interchangeable. Since it boils at minus 40° F., or lower, it is only necessary to release the pressure to bring it once more to its gaseous form, suitable as an engine fuel when mixed with air. When the propane evaporates it absorbs heat. Its refrigeration properties are thus utilised for cooling the body of the vehicle which is driven by the power of the propane gas. The allied gas, butane, compressed similarly in cylinders, is now in frequent use for gas-cookers, etc., in houses to which a coal-gas supply is inaccessible.

Rocket's Live Burden. What is said to be the first transportation by rockets of animate objects is claimed for Mr. S. H. Smith, of Calcutta, by the *Journal of the British Interplanetary Society*. On June 29th last, Mr. Smith successfully shot a rocket over the Damodar River containing two live birds and nearly two hundred letters. A detailed account of this, and other, experiments by Mr. Smith is to be found in the *Star of India*, dated July 1st, 1935.

Fourteen Miles up. Captain Albert W. Stevens and Captain Orvil A. Anderson, of the United States Army Air Corps, ascending from near Rapid City, South Dakota, reached a height of 74,000 ft.—just over 14 miles—in their stratosphere balloon Explorer II a few weeks ago. They thus well surpassed both the official world altitude record of 61,236 ft., established in 1933, and the unofficial record of 72,176 ft. claimed more recently by a Russian balloon. At the maximum height the temperature outside the small gondola of the balloon was −55 deg., and the temperature inside was −7 deg. Captain Stevens reported by wireless that the cosmic rays were 150 times as intense as at the earth's surface and that the sky had become black (shortly after 2 p.m.).

Apes in East Africa Writing from the Natural History Department of the British Museum to *The Times*, Captain Guy Dollman reports the gift of a chimpanzee skull from the Kigoma district in the Western Province of Tanganyika. The donor, Mr. E. W. Savory, did not actually see any of these apes in the district, but the presence of their sleeping-platforms is proof of their residence there, in one of the most south-easterly localities from which the chimpanzee has been recorded.

Blue Starfish Oystermen have recently been startled, says *Popular Science Monthly*, to find brilliant blue starfish in the waters of Long Island Sound. The U. S. Bureau of Fisheries has coloured thousands with a harmless dye and released them to find how far and how fast they travel. Information thus obtained will help combat the damage done to oyster beds by starfish, which devour the oysters.

Byzantine Mosaics Professor Baxter's exploration of the "Sacred Palace" of Byzantium has been both fruitful and full of promise. A very fine mosaic has been laid bare, and the beginnings of many passages afford great hopes for next season's work. The encouraging attitude of the Turkish authorities makes the suggested foundation of a British Institute in Istanbul more than an idle dream.

A German Periodic Lake

We are indebted to a correspondent, Mr. Hermann Schwab, for these photographs of the Bauerngraben, near Rossla in the Harz Mountains of Central Germany. The two pictures, taken from the same angle, show clearly the seasonal change: a sheet of water becomes a meadow, with cattle at pasture.

The Manufacture of Beet Sugar.

By Arthur Haslam.

The conversion of the dull-looking raw beetroots into clean crystals of white sugar is a romance of industry comparatively new to Britain. The complicated sequence of the manufacture makes an interesting story, probably new to many of our readers. For the photographs we are indebted to the Lincolnshire Sugar Company, Limited.

THE question of sugar beet is always certain to provide a lively discussion in the House of Commons. Already strong language has been used in denunciation of the beet subsidy, and, curiously enough, the demand for an inquiry into its operation comes from the party which granted it—the Labour Party. It would be interesting to know how many Members have seen the inside of a beet sugar factory, or have any knowledge of how white sugar crystals are manufactured from the unprepossessing beetroot.

As the public seems to show much more interest in scientific and industrial facts than in political theories, I decided that more was to be learned from a visit to a beet sugar factory than from listening to the speeches in the House of Commons. I went to a Lincolnshire factory, and saw every process from the time the beet arrived at the factory in an open railway wagon as beetroot, until it went out again in a covered wagon as sugar ready for the table.

The first thing that struck me on getting to the factory was the amazing number of beets. Six railway sidings were simply packed full of railway wagons all loaded with beetroots. Men were busy shovelling them out of the wagons into flumes, through which the water rushed, carrying the beets before it. In the swirling waters the beets are cleaned as they rush into the factory.

I followed the beets into the factory, and here another surprise awaited me. I found that trade unionism had already entered the sugar beet industry. In a hut provided by the company sits the representative of the Farmers' Union. His job is precisely the same as that of the checkweighman at the pithead; he is there to see that the farmer is paid for every particle of sugar content he sends to the factory.

The raw material: unloading beets into the railway flume.

A basketload of beets is taken from the wagon and, with the tally number, is conveyed to the sampling room. From this basket are taken six average beets, two large, two small, and two deformed. By a quick but mathematically accurate process, the sugar content in those six beets is recorded, and whatever is the content for those six is taken as an average. The weight of beet in the wagon is already known and, as the farmers' representative knows the sugar content in the beet, the farmer sending the consignment is assured that he will get the agreed value for his load of beets.

According to the agreement between the manufacturers and growers, the six beets tested must show an average of 15½ per cent. sugar content, that is to say, 15½ per eent. of the total composition of the beet must be sugar. If it is higher than 15½ per cent., the grower is paid for the additional percentage.

In the test room I was handed a small mass of pulp representing that part of the beet which contains the sugar. This pulp was placed in a small jar, a solvent of lead was poured over it and the whole hermetically sealed. In a few seconds the solvent had done its work, the rubber stopper was removed, and what went into the jar a piece of pulp came out a crystal-clear liquid. This liquid is now poured into a receptacle and placed in the little machine which records the test. Looking in through a little lens one can see the sugar family separating itself from all the other substances. A clear light is at first seen at the far end of the lens, but when a dark shadow is thrown across this, the test is complete, and by looking in through another parallel lens it is possible to read the precise amount of sugar content of the sample.

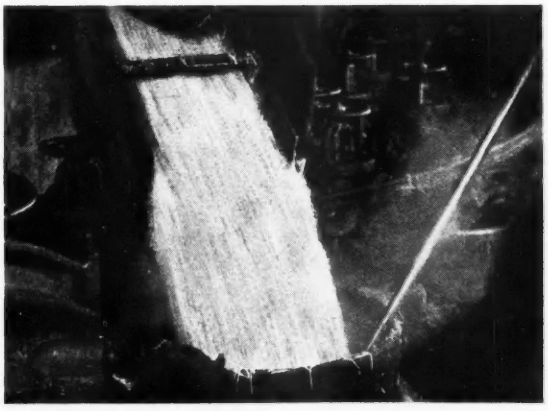
After the washing, the beets are swirled on to an elevator, which takes them up to the top of the factory. Still without a hand touching them they are passed over automatic weighing machines ond on to the beet slicers. These revolving knives cut the beet into three strips of about one-eighth of an inch in thickness. These thin strips, known as "cossettes," are passed along to the diffusion battery, where all their juices are extracted.

Water passes from one tank to another through pipes,

beginning at the tank where the cossettes are practically exhausted and finally being drawn off as diffusion juice from the tank containing the freshest cossettes. What remains of the cossette is discharged from the bottom of the tank and pumped to a pulp dryer. Here a system of fans dries it and the residue is filled into bags, making an excellent cattle feed.

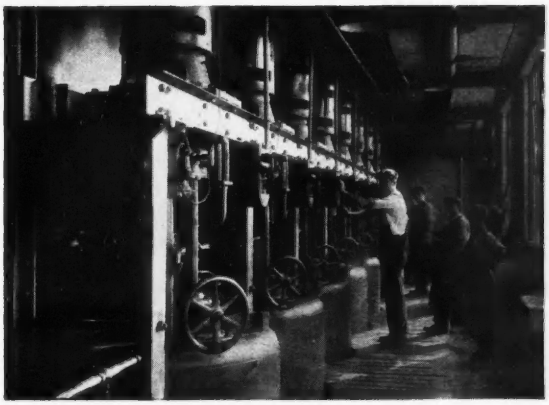
Now there is nothing left but the so-called diffusion juice. This juice is pumped through heaters into the defecation tanks, where milk of lime is added, the amount of lime being determined by the nature of the beets that are being worked. The juice with the milk of lime then passes into the first carbonators, where it is treated with carbon dioxide gas until most of the lime has been precipitated as calcium carbonate.

When this process is completed to the desired point, the whole mixture is pumped from the carbonator through a heater to what are called first filters. In the modern factories these filters consist of thickeners, where most of the juice is drawn through the filtering medium, leaving behind what looks like an unpleasant thick mud. This mud, which is really the lime, then passes on to a drum-type vacuum filter, which keeps revolving with the lime adhering to it. While it is



Sliced beets, or "cossettes" descending to the diffusion battery for juice-extraction.

revolving, water is being sprayed on to wash away any sugar remaining on the lime cake. Purified juice from the first filters, known as "first press juice," is pumped to the second carbonation process where most of the remaining lime is precipitated by means of carbon dioxide gas. Next the juice is sent through heaters to the second thickeners and vacuum filters, where the precipitated calcium carbonate is removed as "second lime cake." The juice is now known as "second press juice" and is sent to a third saturation, where it is



Centrifugals, in which the crystals are finally separated.

treated with sulphur dioxide. After the treatment with sulphur gas and a further filtration through the thin juice filters, the juice, which has now become "third press juice," enters the evaporator where it is concentrated to a syrup containing about 50 per cent. sugar.

From the evaporators the thick juice goes to the melter, at which station melted sugar is mixed with it. The resultant mixture is then pumped to the thick juice sulphur station, where it is treated with sulphur dioxide gas, and then passes shrough thick juice filters, after which it becomes a syrup known as "blow-up thick juice." This last material is drawn into the "white vacuum pan," where it is concentrated to such a point that the sugar crystallises out, the whole mass of crystals and liquor surrounding them being called "white massecuite." The white massecuite is placed in centrifugals, where the crystals are retained on a screen, and the syrup surrounding the crystals passes through and becomes known as "high green."

Since some of the syrup remains on the crystals, it becomes necessary to wash them with a spray of hot water, and the syrup made by this washing is called "high wash." What is washed off goes back again, and after another process turns into melted sugar and is used to mix with the next making of sugar. Everything has now been extracted from the original juice, all that remains being the white sugar crystals. When these are dried by hot air in the granulators they come rushing down a round chute. At the foot of this are men who have fixed a large sugar bag to the opening of the chute, with the bottom of the bag resting on an automatic weighing machine. When the machine has recorded the desired weight, a lever is pulled, the chute is closed, the bag is sewed up by a machine and rushed out to a van which may take it to any part of Britain.

The Bimillennary of Horace.

By Cyril Bailey, D.Litt., F.B.A.

The 2,000th anniversary of the birth of the poet Horace raises the question of his continued popularity. Dr. Bailey suggests reasons why we appreciate him less than our ancestors did and grounds for the permanent recognition of his greatness.

To celebrate the birth of a Roman poet two thousand years ago requires a degree of imagination and enthusiasm of which, perhaps, the British people is hardly capable. The Horatian Society has held a bimillennary dinner in London, the Classical Association devoted two papers to his memory at its annual meeting at Southampton and there have been commemorative lectures in several of its branches; the Bodleian has more recently held an exhibition of Horatiana. But all this falls far short of the eagerness with which the occasion has been celebrated in America, where a vast organisation secured commemorations in almost every University, College, and School throughout the United States. The fault—if fault it is—lies partly with our phlegmatic temperament. Yet there is something also in the generations. It is characteristic of our times that there was far more enthusiasm among English scholars in 1930 over the bimillennary of Virgil's birth than there has been this year over Horace, but had these two celebrations fallen a century earlier, there can be little doubt that Horace would have been the favourite. Englishmen of the 20th century are apt to demand something more of their classical poets than exquisite verse, common sense, and shrewd maxims; they want depth of thought, and *sunt lacrimæ rerum* makes a more immediate appeal than *carpe diem*. But to Georgian England, brought up on the classics as an essential part of a gentleman's education and living on a standard of gentlemanly morality, Horace seemed a closer and more natural expression of their outlook on life. There used to be in Victorian times—perhaps it still exists—a breakfast compound known as "Patum Peperium, the Gentleman's Relish"—salted anchovy with a dash of pepper; it is not a bad description of Horace's flavour as a satirist, and it was what the Georgian gentleman relished.

The Augustan Gentleman.

Yet after all, if we cannot all quote our Horace as our grandfathers could, if some of us would hesitate to place him in quite the first rank of the poets of the world, we may yet rejoice that he was born in 65 B.C., and that his "monument more durable than bronze" has survived to us through the centuries. For, in the first place, he is of all the Augustan poets the truest representative of his age. Tibullus, with a sincere love of the country and its life, which endears him to us, was remote from the city life on which Augustan Italy was focussed; Propertius, with his long-drawn amatory drama, is one-sided in his emphasis. Ovid, garrulous, cynical, querulous, is perhaps the greatest of story-tellers, but too shallow in his outlook to represent the more serious of his contemporaries; Virgil, on the other hand, is too deep; he is what we might wish the Augustan age to have been, but it wasn't. Horace stands out above them as the man of his time; as we read him, we live in Augustan Rome or retire to the week-end Sabine farm. We recognise the perfection of Augustan culture, the sincerity of the coterie of Mæcenas, in which "every man has his niche" and neither wealth nor learning can place one man above another, the intolerance of the bore and the parvenu, the simple elegance of the man of the world. And behind the surface of "wine, woman, and song" we detect a wise, kindly philosophy of life, which does not eschew thinking, and out of a strange compound of Epicureanism and Stoicism constructs a Roman morality, which, if it is much overlaid with a Hellenistic love of pleasure, yet has its foundations set deep on the traditional *gravitas* of the Republic. If we want to know the Augustan gentleman both in his lighter and in his graver moods, it is to Horace that we must turn.

Artist, Poet, and Moralist.

Nor is Horace lacking in those permanent qualities which make him a "possession for ever." He is to poets a model of workmanship; if there is conscious art (*curiositas*) in all his work, it always results in *felicitas*, the happy expression which makes the reader sure that in no other way could the thought have been better put. If Catullus's lyrics are the genuine rough-hewn diamond, Horace's Odes are the piece of jewellery in which every stone is set and framed exactly as it should be. Nor is there any sense of constraint; his thought is never confined to a rigid pattern, but flows on gently like a winding stream touching now on one projection on the bank and now on another, yet always the same stream. There is no less art, though it is less obvious, in Satires and Epistles, art which often seems

to neglect art, but is in reality only concealing it. He broke the majestic hexameter into colloquialism. Lucilius before him had failed to do it ; he " flowed with a muddy stream " ; and Juvenal had lost the knack and returned to a statelier and less appropriate verse. There is an artistic perfection in Horace which perhaps only Virgil of the other Romans attained—and that in a very different sphere.

And if preachers and stern moralists look askance on Horace's doctrine of the " golden mean " and his injunctions against enthusiasm (*nil admirari*), yet there is much to be said for it as a guide in times of great political and social disturbance, such as those through which he lived. There are critics who would like to explain away Horace's mistresses and his drinking-bouts ; some tell us that he was describing what he saw, not what he practised ; others still less convincingly, would put an allegorical interpretation on them. There is no need for this ; Horace was not superior to the morality of his age, but his moderation taught him where to set the limits, and made him as genuinely happy when he was dining on his simple cabbage in his cottage as he was at a banquet in Rome. He kept his head, he knew what he was doing, he scorned display and ambition and was content with a pittance and the joy of friendships. It is not an adventurous or even courageous attitude to life, yet it needed discrimination and determination to apply it, and these are qualities which have a high value in the world of men and affairs. We shonld have enjoyed sitting next Horace at dinner, but we could also have learned much from him in the study. There are pictures in Horace which tell more than his precepts. Regulus moving aside his friends as he started to return to Carthage, the just man who clings to his purpose and is not deterred by the tyrant, Virtue that knows no base defeat and will not assume or lay aside office at the bidding of the breath of popularity—these are visions which abide with us as poetry and give us glimpses of a serious view of life, which frivolity elsewhere only sets in higher relief. He thought of himself as an inspired teacher (*Musarum sacerdos*) in those great odes at the beginning of the third Book ; he, too, like Virgil, in his own tempered way, had seen the vision of the new era, and he knew that it would not descend spontaneously from heaven, but needed the self-control and goodwill of men to bring it to pass.

The country of the Sabine Farm, Horace's week-end retreat.

(*Photograph by R. Gardner. By courtesy of the Oxford University Press.*)

The National Parks Question.

We are glad to take the opportunity of heartily endorsing the remarks of *Nature* on the lack of a National Park in the British Isles. Commenting on a recent census of the wild animals in the Polish National Park of Bialowicza—in which 17 head of European bison (including half-bred specimens) have been preserved, as well as wolves, lynxes, otters, martens, and other commoner species—and on the official issue of sets of pictorial postcards of the park and its inhabitants, our contemporary justly observes : " It is curious to look upon these activities in Poland and the interest of the State and people in them, and to consider that in our more highly populated land, where the need for protection is greater than in Poland, there is no national park at all, and no State attempt to protect the disappearing land mammals, which were once as varied in kind as those of Poland now are."

War Against Yellow Jack.

By A Tropical Bacteriologist.

The modern traveller is so accustomed to conditions of comfort and safety in all latitudes, that a reminder of those who have secured these conditions is not out of place. The spectre of "Yellow Jack" is only just laid, and a keen look-out has to be kept against a possible revival of his horrors. The article which follows is written from first-hand experience by a well-known bacteriologist, whose work in tropical Africa has been of the highest importance.

Up to the end of the last century, the infinitesimal microbe of Yellow Jack, as the sailors called it, was perhaps the world's most ghastly slayer. Ships disastrously carried it far and wide from its tropical home, even to England; and during a visit to Gibraltar it destroyed half the population. It was time to come to grips with the enemy. But he was well masked, and quite unknown; there was only the destruction he wrought, the heaps of slain on the battlefield, but as to himself, his weapons and his strategy, and how to launch an effective counter-attack upon him, humanity was in the dark.

As has been supposed, and often rightly, with all diseases, yellow fever was thought to be conveyed by "fomites"—or infected clothing, bedding, and such things. But might it not possibly, like malaria, be carried by a mosquito? There was only one way in which to decide that urgent question—by a human experiment. And so, in 1900, a band of American scientists went to Cuba, then in the terrible grip of Yellow Jack. In a specially erected, ill-ventilated, badly lighted wooden hut near Havana, seven of these investigators slept for sixty-three nights, not only in beds which had recently been occupied by yellow fever victims, but in their night-clothes and blankets, which had been soiled horribly with their "black vomit" and other obnoxious discharges. But nothing happened to them, beyond the fearful discomfort.

Lives Sacrificed in the Cause.

Not until they tried experimental conclusions with the small mosquito called *Stegomyia fasciata*, which lives in all the warmer parts of the world, did anything occur. Some of these mosquitoes, after feeding on yellow fever patients, were allowed to bite volunteers—and violent illness from yellow fever followed—with the loss of a fine life (Dr. Lazear). The problem thus cleared, war was made on the Stegomyia, and Havana was quickly rid of that scourge which had afflicted the town for 200 years.

But what was the enemy himself? Much laborious research has revealed him as a "filterable virus," minute enough to pass through the infinitesimal pores of an unglazed porcelain filter, which completely holds back all ordinary bacteria such as those of typhoid or pneumonia—extremely minute though these are. To deal with the problem and make protective vaccines and serums, British scientists went to West Africa, the stronghold of the enemy, and brought back to their laboratories a culture of the virus, preserved alive by freezing; this again with the loss of a fine life (Dr. Stokes). Yellow fever virus could not be cultivated in tubes and flasks, as so easily can the microbes of plague and typhoid, to make protective vaccines. It is necessary, as with the filterable virus of rabies or hydrophobia, to grow it in the bodies of animals, monkeys or mice in this case, in order to get it in sufficient quantities to work with effectively.

A Successful Weapon.

By an elaborate process, that of Hindle, a monkey artificially infected with yellow fever is killed, its liver and spleen, full of virus, are taken out and ground up into a fine paste; from this the virus is extracted with distilled water, and killed by the addition of a little disinfectant. The result is a vaccine which, when tested on monkeys, was found to protect them against yellow fever infection for a period of about six months. But, unfortunately, it is less useful for the protection of humans. However, the blood-serum of convalescent patients was found to protect other people when injected with it, just as is the case with measles, another filterable virus disease. And by repeatedly and cautiously injecting virus into horses, their serum comes to be rich in the so-called "antibodies" or natural antidotes to the virus. Such serum, or better, a mixture of it with the virus itself—the virus being neutralised by the serum—has been used with considerable success to help combat outbreaks of Yellow Jack.

But the main victorious campaign is still against the "enemy's agent," the ubiquitous mosquito Stegomyia—blotting out his breeding places in little collections of water in holes in trees, banana leaves, and such. And here the League of Nations enters, with its alliance of civilised peoples against their common foe the Microbe. How many know of the mighty hand that the League of Nations, with its International Health Organisation, lends in our Great Microbe War? There is now the

novel danger of infective disease being carried with disconcerting swiftness over great distances about the world, by aeroplanes transporting infected human or insect passengers. The institution of an air service across Africa, for example, would mean risk of bringing infected Stegomyia from the West Coast into Kenya, where yellow fever has never to our knowledge yet occurred. And as far as the native population, some two million strong, is concerned, we now know that practically all of these natives are susceptible to Yellow Jack—waiting only for infected mosquitoes to start a fearful epidemic. But how was that popular susceptibility to the disease discovered—with the result of stimulating effective attention to means of preventing such a disaster?

It was through following up the already noticed fact that blood serum from previously infected human or animal subjects protects others by neutralising the virus which happens to be introduced into them by an infected mosquito's bite. The medical authority of a country, say Kenya, collects specimens of serum from large numbers of people in different parts of the region, so as to form a sufficiently representative sample, and sends these to the Rockefeller Institute for Medical Research, the workers of which are engaged in a large-scale investigation into regional susceptibility to yellow fever. The procedure, simply expressed, is to inject into mice a mixture of the serum to be tested and yellow fever virus. If the serum should contain the specific antibody, it will protect the mouse against the virus, and *vice versa*. A dead mouse means that the human being concerned in the test has no natural or acquired immunity. The Rockefeller research has also indicated that in certain populations Yellow Jack is at work, or has been so, in an unobtrusive way unsuspected by the medical authorities—who have thus been put on their guard.

But the heyday of Yellow Jack is over; though he still shows his horrible face here and there about the world, he is now a mere shadow of his old self. But those who are about to go South on some pleasure cruise may well remember, while in some lovely southern harbour they dance on deck in the dreamy tropic night, those many men who have given up their lives in the great war against disease, so that their fellows might be safe from their death-dealing microbe enemies.

(*Continued from next column*)

These civic musicians were required, moreover, for the theatre and especially for the grand processions that opened the circus games. A tombstone shows such a civilian musician, with lituus and pandean pipe, the latter an equally unmilitary instrument.

What was the Roman Lituus?

By Alban Voigt.

It is a matter of common knowledge that the Roman augurs used in their ritual a short staff with a large curve, called *lituus*. Another lituus, evidently derived from the Etruscans, similar to the one just mentioned, was an instrument said to have been used by the Roman cavalry. There is one in the museum of the Vatican, found in a tomb near Cervetri, the ancient Etruscan Cære. It is just over four feet long, is made of bronze, and corresponds in shape exactly with such an instrument painted in a tomb at Chiusi, where a victor in a chariot race is shown, preceded in a procession by a *liticen*, as the performer on the instrument was called.

It is a strange thing that this instrument is hardly ever mentioned in Latin literature. The *Epitoma Rei Militaris* of Flavius Vegetius Renatus tell us (III, 5):

> Semivocalia sunt quæ per tubam aut cornu aut bucinam dantur; tuba quæ directa est appellatur; bucina quæ in semet aereo circulo flectitur; cornu quod ex uris agrestibus, argento nexum, temperatum arte spirituque canentis flatus emittit auditum.

Not a word is said in the whole book of Vegetius about the lituus. Nor does Procopius, a very learned Greek who accompanied the Roman army when it started the siege of Carthage, mention this instrument. Why should the lituus be excluded from all military reports when tuba, buccina, and cornu are mentioned?

In the early Middle Ages a manuscript was discovered which bore no author's name and was judged by some scholars to date from the 2nd century A.D.; by others it was considered to be much younger. In this MS the lituus was mentioned as the instrument of the Roman cavalry, and the scientific world accepted it as truth; for did not Ovid say in *Fasti*, III:

> Iam steterant acies ferro mortigue paratæ,
> Iam lituus pugnæ signa daturus erat:
> Cum raptæ veniunt inter patresque virosque
> Inque sinu natos, pignora cara, tenent.

But can we take it for granted that Ovid was so well informed about the armament of the Romans in the first fight they had? Did not poetic licence, coupled with metric requirements, influence his choice of words? Moreover, can any instrument be imagined more inconvenient than the lituus for a man on horseback? Would any army supply its cavalry with an instrument four feet long, when a short trumpet answers the purpose much better?

The fact is, the lituus was not a military instrument at all. It was sounded in civic festivities, in funerals, which, at one time, were celebrated with so many instrumentalists that the Senate had to fix a certain number which on no account was to be exceeded.

(*Continued in preceding column*)

Science in the Home.

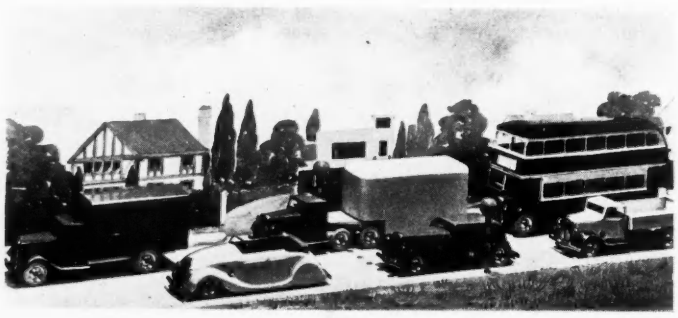
Modern research, besides the great work it has done towards the improvement of the major industrial processes, has helped much towards adding attraction to our daily life. There are few occupations that have not benefited, and at this season it will not come amiss to describe a selection of recent inventions that can bring pleasure and profit to all the occupants of a present-day home, from the oldest to the youngest.

The child of to-day is faced by so bewildering an amount of evidence of the progress of science, that it would seem increasingly difficult for his growing brain to absorb the ideas that beset him. Fortunately the normal child has an almost limitless capacity for taking things for granted, and it is not until he is older that he becomes interested in the multiplicity of scientific developments. A convenient approach towards this interest is provided by the toymakers of to-day, and mechanical playthings have lately attained a perfection and a variety astounding to the children of the last generation or so. A tour of inspection through an establishment devoted mainly to the amusement and instruction of children, such as Hamleys of Regent Street, must be of great fascination to anyone interested in mechanically minded youth.

Transport of all kinds, as usual, plays a conspicuous part. The model aeroplane of to-day really works, and it has at last been found possible to construct one without the disproportionately large propeller hitherto essential. The Miles " Hawk-Major " constructional set enables the budding air-mechanic to produce a model ' crash-proof ' aeroplane in sufficiently light material to be made to scale throughout ; a cheaper ' indoor ' aeroplane is the product of the " Flying Flea " constructional set. The " Electrostatic Aeroplane " is a very cheap and amusing toy, demonstrating the principle of frictional electricity. Road transport is not forgotten, and a complete set of working models—cars, buses, beacons, etc.—representing a modern road, has been designed all to one scale. For younger motor-fans there is a model of the " Blue Bird," with a very simple winding system (no key to lose) ; while an elaborate model garage in three sizes, with working supplies of oil and petrol, adds another touch of realism. The new electric Cabin Cruisers show a great advance in model boatbuilding.

Floodlights, domestic lighting and bell systems, and dial telephones are procurable with handy batteries for working them ; and the " First Home Talkie "—actually a combination of cinema film and gramophone record synchronised—gives a good idea of another striking feature of modern life.

To the rather older explorer in the field of Science, whose expanding mind demands some knowledge of the principles on which things " work " what better encouragement could be given than a set of Construments to employ his leisure moments? Construments are not toys : the optical outfits which bear that name consist of precision-made parts, the mere use of which teaches precision in working. All kinds of optical models can be made with the aid of these sets, from the purely entertaining kaleidoscope or distorting mirror to the really useful microscope, cine-projector, or epidiascope. The instruction book issued with the sets is unusually detailed and explicit, and the system by which single components can be bought separately enables the young operator to extend his activities in any direction that may specially interest him.



Miniature roadway with ' Minic ' scale-model vehicles.

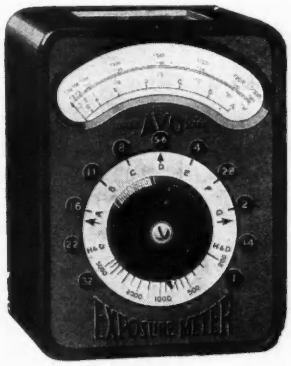
The makers of the well-known Burgess " Snaplite " pocket torch, with the protected bulb, have produced a most ingenious combined flashlight and screwdriver, with insulated handle, a most useful tool not only for the practical purposes for which it is primarily intended (work in the interior of typewriters, wireless sets, etc.) but also for the young mechanic who likes to construct his own models from his own materials. Not the least attractive feature of it is the very moderate price.

A real advance in that most popular of all applied sciences—photography—is afforded by the appearance of the " Avo " Exposure Meter, for both still and moving picture cameras, which goes far to avoid that bugbear of the amateur photographer—disappointment at the results attained. Though incorporating a recent invention, the photo-electric or light-sensitive cell, this ingenious meter is extremely simple to work and is practically " fool-proof." It gives direct reading of exposure time

or " f " stop without calculation. A simple setting is made to allow for the speed of the plate or film which, when set, need never be altered unless films of a different speed are used. The meter is extremely sensitive to weak light and is designed in such a way that extraneous light outside the normal picture angle is excluded.

The meter is free from the errors due to eye fatigue that arise with the optical type, or to guess-work with certain other types, while the instantaneous indication of exposure immediately before taking a photograph is conducive to suitable exposures under rapidly changing light-conditions.

The principle of operation is as follows : light reflected from the subject impinges on to a photo-voltaic cell, generating an electric current of strength directly proportional to the value of the light. This current is passed through a sensitive moving coil meter, the sensitivity of which can be varied at will by the rotation of the knob. This change of sensitivity takes place in such a manner as to agree with the positioning of the " f " stop values shown on the moulded cover, and the various scales marked on the disc.



The Avo photo-electric exposure meter.

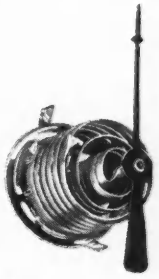
The scale plate has three time-scales of different colour ; each for use in conjunction with an arrow of its own colour on the disc, to indicate the stop.

Two simple methods enable the operator to work either to a chosen exposure time or to a definite stop, while a special arrangement applies to cine cameras. For example, for cine cameras of standard shutter speed (1-32 sec. exposure time) the meter is pointed towards the subject, and the knob rotated until the pointer indicates one of the letters ; the stop to use is shown opposite the same letter on the disc.

An invention that is of equal service to industrial and to domestic life is embodied in the " Rototherm " bi-metal thermometer, which (according to the model chosen) is as much at home on the drawing-room mantelpiece as on the foundry wall. Until the introduction of this thermometer there had been no real advance in accurate thermometer design since the first glass bulb instrument was produced by Galileo nearly 300 years ago.

The word " bi-metal " is used for a composition of two metals with different expansion co-efficients—that is, when these metals are exposed to the same temperature, the expansion of one is greater than that of the other. It is now possible for such a material to be produced with so careful control and tolerance in thickness and width that, by winding it into a very ingenious triple helical torsion spring, a thermometer system can be made with effective length of 26 in., which is necessary to give constant temperature over the full deflection, and a rigidity and elasticity capable of withstanding considerable vibration.

Originally it was only possible to use a straight strip of bi-metal when sensitive transmission units were used in conjunction with it. Transmission units, however, are complicated, expensive, and liable to cause errors. A later simplification of the construction, by making the bi-metal in the form of a single spiral, resulted in the free end of such spirals giving a circular movement to a rotating hand. Lack of stability of the single spiral and its own expansion necessitated the use of very small spirals only, and consequently the rotating force was very small. These disadvantages were overcome by the invention of the stepped torsion spring which is shown here, and this system gives a maximum stability, torsional force, and elasticity.



Stepped torsion-spring of " bi-metal " actuating the thermometer scale-pointer.

One of the most interesting uses of this thermometer is for horticultural work, where instruments in glass frames, etc., can be read without having to admit the cold air. Another important model is that for the bath, which has a rotating scale and floats upon the surface of the water, indicating the temperature of the bath. This is particularly suitable for use when bathing babies. So Science and its applications lead us back to our starting-point—the growing generation—who after all deserve the consideration of even the most learned, perhaps especially at this season of the year.

The preceding article was written and its title chosen before we heard of the publication of *Science in the Home*, by W. B. LITTLE (Pitman. 3*s*. 6*d*.). This excellent little volume is the last word in the campaign against the " Black Magic " attitude to Science, and offers a lucid explanation of the many ways in which Science has entered benevolently into everyday life. The chapter on *Science and Cooking* should be read by everyone concerned with the preparation of food. Simultaneously appears *Food Values at a Glance*, by V. G. PLIMMER (Longmans. 3*s*. 6*d*.), a handbook which really justifies its title. Not only are various forms of dietary concisely discussed, but an extremely simple system of coloured diagrams shows just where various foods are advantageous and where they are not.

National Trust News.

At the present time numerous schemes are afoot in which the National Trust is directly or indirectly interested. The Trust itself issues appeals only in rare and special instances, but many a local scheme is drawn up with the approval of the National Trust to "save" some local landmark and then hand it over for permanent keeping. Several years ago an "Association for the Preservation of Local Natural Beauties" set itself the formidable task of raising some £7,500 for the Watersmeet Valley near Lynton in North Devon. In large amounts and small, laboriously collected by divers means that occurred to them, the balance required has now been reduced to approximately £1,000 and the end at last seems to be in sight.

Local enterprise is responsible also for a proposed extension of the Longshaw Moor Estate which, although it is actually in Derbyshire, is close to Sheffield and greatly enjoyed by her large population. The estate formerly belonged to the Dukes of Rutland but was broken up and sold: Longshaw Lodge and 765 acres were bought for the National Trust and a sizeable portion of the adjacent country became part of a catchment area for Sheffield's reservoirs, so that this also was protected against disfigurement. The present scheme is to extend the property northwards by adding land which is in the foreground of the "Surprise View": this is at a point where the road over the Moor suddenly turns a corner and discloses a striking view into the valley of the Derwent. The amount still required is £1,500.

Another appeal which the National Trust regards as worthy of support is one for buying land above West Runton (near Cromer) to protect the so-called Roman Camp. The Camp was secured by subscription in 1924 and two additions, of which this is the second, have increased the area from 30 acres to 66. The ridge of hills in question is the highest in Norfolk, consequently the views from it are very extensive. The Local Committee have been begging for so long in the praiseworthy desire to retain their amenities that they are now finding it difficult to raise even £130 which is all that they now need.

At the opposite end of England an effort is being made for Pentire Head, in North Cornwall near Polzeath. The scenery here is very striking and although the actual cliffs cannot easily be disfigured there is a risk of development on the farmland behind. The Fund was started only a short time ago, but, thanks to the support of the Press, about £1,000 has been raised towards the necessary £7,500 needed for the preservation of this and the neighbouring headlands. The area is 350 acres, apart from further properties nearby which can probably be protected, without cost, by arrangement with the landlords.

Finally, there is the Malvern Hills Preservation Scheme, first announced last May. This scheme provides for the safeguarding through restrictive covenants of all the southern part of the Malverns, the northern part being safe already under the guardianship of Conservators. The public have long enjoyed the privilege of access to the beautiful stretch from the British Camp to Ragged Stone Hill, but there has been no guarantee that the scenery would remain even substantially in its present condition. This can now be made a certainty if the scheme is carried into effect, for the landowners concerned have agreed to renounce their building and quarrying rights provided they are properly compensated. Such an arrangement will be eminently satisfactory and the Pilgrim Trust having made a generous donation (to commemorate the King's Silver Jubilee) there only remains £2,750 to be raised.

All the projects described above are in urgent need of funds to complete them and contributions will be gratefully received by the Secretary, the National Trust, 7, Buckingham Palace Gardens, S.W.1.

A Famous Hill.

During November the National Trust accepted from the Viscountess Rhondda and the Dowager Viscountess Rhondda its second largest gift of land, some 2,130 acres of the Sugar Loaf just north of Abergavenny, together with covenants over Park Lodge, the farm in the hollow below. This magnificent hill, well known in South Wales and Monmouth, is at the south end of the Black Mountains and rises to a height of nearly 2,000 feet. From the top there are fine views northwards to the Black Mountains, while to the west is Mynydd Llangattwg and to the east the Skirrid Fawr. To the south-east the view extends towards Usk and Monmouth, where the Kymin, another property of the Trust, can be seen. Hitherto there have been very few Trust properties in this neighbourhood and the National Trust are very glad to have this opportunity of preserving so magnificent a stretch of country as a menorial to the first Viscount Rhondda and on the occasion of the Silver Jubilee of their present Majesties.

The British Science Guild.

The sixth Alexander Pedler Lecture, entitled *Antarctic Exploration, Past and Present*, by Commander L. C. Bernacchi, O.B.E., and the eleventh Norman Lockyer Lecture, entitled *The Calculus of Plenty*, by Sir Josiah Stamp, G.C.B., G.B.E., have now been published by the British Science Guild. Copies of either lecture, price 1*s.* 1*d.* post free, may be obtained from the British Science Guild, 6, John Street, London, W.C.2.

Correspondence.

OIL FROM NEW ZEALAND.

To the Editor of DISCOVERY.

Dear Sir,—A few years ago you published a short note from myself concerning the introduction of the tung oil tree into New Zealand: I then promised you I would write you about developments later on.

A number of companies have been formed in New Zealand to plant tung oil trees. Unfortunately a number of them have been strangled at birth owing to ill-considered actions and policies. However, a number have gone steadily forward and the trees are showing good growth. Over a million trees are now rapidly progressing to the bearing stage.

Some small plantations are already bearing fruit. The oil has been extracted and analysed with very favourable results. The young seeds have yielded over 26 per cent. of oil, which compares favourably with that produced in other parts of the world. The quality is also as good as that produced anywhere else.

The trees show amazing growth and there is no doubt this country in a few years will enter the tung oil market with large quantities of oil.

Yours faithfully,
EDWARD S. LITTLE.

Keri Keri, New Zealand.

CATS AND CATMINT.

To the Editor of DISCOVERY.

Dear Sir,—I was both amused and interested to read the correspondence in your paper on the question of the behaviour of cats with catmint.

A friend of mine in Norwich complains bitterly of the impossibility of keeping this bush in good condition, because all the cats of the neighbourhood seem to come and roll in it with a furious delight, or what seems like delight. For myself, I have been divided between amusement and irritation as I have watched from my breakfast-table, morning after morning, my neighbour's cat stroll into my garden, make straight for a bunch of very dry and withered catmint and, literally, graze upon it, biting and chewing with every appearance of intense delight. This has been his custom both before and since his sterilisation. So far as I know, the plant is just the very ordinary variety of Nepeta.

Yours faithfully,
MARIAN CALDWELL.

Sedgley, Dereham.

NORWICH CLOISTERS.

To the Editor of DISCOVERY.

Dear Sir,—Several Members of the British Association present at Norwich expressed to me the feeling that it would be a pleasant thing to commemorate a delightful occasion and at the same time to make some slight return for the charming hospitality received by us during its course. They expressed their willingness to contribute to some object in which the citizens take especial interest and pride.

Such an object exists in the very beautiful cloisters of the Cathedral, which are being cleaned and brought back to their pristine condition as funds allow, this being done in such a way, and with such extreme care, that all the old work is preserved uninjured, while the original painting of the roof bosses is being renewed.

The cost of dealing with one of the cloister bays varies from £60 to £100 according to its size, character, and condition; and if the Association were to bring about the reclamation of one bay or more it would be regarded as a permanent memento of our visit.

It is foreign to the practice of the Association to take official action in a matter of this kind, but it would be a great pleasure to myself to receive and acknowledge any sums entrusted to me for the purpose indicated, and to hand them to the Authorities of the Cathedral.

This circular is being sent only to those Members, not resident in Norwich, known to have attended the meeting, but I should, of course, welcome help from any other Members willing to contribute.

Faithfully yours,
W. W. WATTS.

39, Langley Park, Sutton, Surrey.

Some Gift Books.

A pictorial introduction to the appreciation of Science is always pleasant; doubly so when it is presented in so attractive a way as is provided by some recent publications. We refer particularly to *World beneath the Microscope*, by W. WATSON BAKER (The Studio, Ltd. 6s.) and *Nature in the Wild* (Country Life, Ltd. 5s.). Of these the former is the second number of the "New Vision" series; in addition to 80 plates of microscopic wonders it includes a short introduction, with notes on photomicrography, the preparation of slides, and the use of the microscope itself. The photographs themselves are of all kinds, mainly biological, but with some mineralogical and industrial examples. It would have been helpful if a note of the magnification of each subject had been appended.

The photographs in *Nature in the Wild* are a selection from those shown at the "Country Life" Exhibition of Nature Photography at the Natural History Museum, South Kensington, and a very good selection, too. The scientific side of nature photography is well brought out; and a word in the introduction on the debt owed to the skill of camera-makers is well worth noting.

Messrs. McGraw-Hill place amateur and junior astronomers in their debt by publishing the *Handbook of the Heavens* (5s.), the introduction to astronomy sponsored by the American Museum of Natural History. The learned editors are supported by a host of contributors and Professor HARLOW SHAPLEY, Director of the famous Harvard College Observatory, adds a foreword as brief as it is to the point.

Bermuda and the Gulf Stream.

By Walter Garstang, M.A., D.Sc., F.L.S.

Emeritus Professor of Zoology, University of Leeds (formerly Naturalist in charge of Fishery Investigations under the Marine Biological Association).

We are glad to have the opportunity of broadcasting the following appeal to Britain to help the Biological Research Station in Bermuda to record the fluctuations of the Gulf Stream, so that, in connection with other data, the variable influx of Atlantic water on the coasts of Europe may be predicted.

IN his *Fleet Street Recollections* the late Sir John Robinson told of an M.P., shortly after the Burmese war, who, meeting a young fellow home on leave, remarked, "Ah, yes, Burma! I had a nephew there, but he always called it Bermuda!" A commoner and more excusable mistake is to confuse Bermuda with West Indian islands, such as the Bahamas, Barbuda, or Barbados. Yet Bermuda is not West Indian: it is separated from the nearest of the Antilles by over 700 miles of ocean and one of its deepest abysses. It is, in fact, the most lonely island of the North Atlantic, equidistant from Nova Scotia and the West Indies, and only a little less remote from the Carolina coast of the United States.

A Submarine Pinnacle.

It is also the apex of one of the deepest and steepest of submarine pinnacles in the world. Most of the other small Atlantic islands rise as peaks from more or less extensive ridges or plateaux less than 1,000 fathoms in depth, but Bermuda rises sheer from a depth of over 2,000 fathoms. Its base is an outburst of black volcanic rock, its summit a cap of æolian limestone, now mostly submerged. Its few main islands, united by bridges and causeways, lie close together, forming a narrow strip 12 miles long by 2 miles wide, which borders the southern side of a larger area of submerged reefs and calcareous mud, mostly 6-8 fms. deep. The whole of the area within the 10 fm. contour is only 28 miles long by 12 wide. Its sides fall steeply into the abyss, especially on the S.E. side of the island strip, where the depth may be said roughly to increase by 100-200 fms. per mile seaward. Here there are places where 500 fms. can be reached within 3 miles from the shore, and 1,000 fms. within 5 miles—a slope of 1 in 4½, which motorists, at any rate, will be able to appreciate. This region can be reached from the Biological Station in a little over half an hour, and has already been rendered famous as the scene of Dr. Beebe's descents in the "bathysphere."

Towards the close of the 19th century Bermuda became a happy hunting ground for American naturalists on account of its facilities for the study of living corals and the various forms of life associated with them and its agreeable and healthy climate. A comprehensive work on the natural history of the islands by the elder Verrill dates from this period (VERRILL, *The Bermuda Islands*, 2 vols. 2nd edition, 1907). From 1903 it was the seat of a regular summer school of research under Prof. E. L. Mark, of Harvard, and seven stout volumes, containing 170 published articles, attest the value of the work done under these auspices for a period of 28 years (1903-1930).

Finally, the promoters formed a Corporation to reorganise the Biological Station on a more permanent and wider basis, with the idea of making it an important centre of oceanographic research. The Colonial Government gave direct support to the scheme and provided an admirable site with convenient buildings (a former hotel) near St. George's at a cost of £5,500, together with a recurrent grant of £200 per annum for ten years. An endowment of £50,000 was simultaneously provided by the Rockefeller Foundation. The new Station was opened in 1931 by the Governor, and an Englishman with oceanographic experience, Dr. J. F. G. Wheeler, of the R.R.S. *Discovery*, was appointed Director.

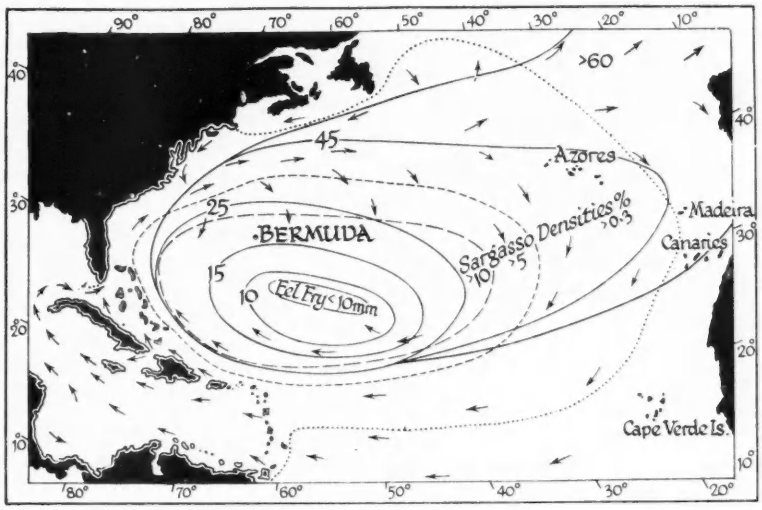
Watching the Gulf Stream.

Unfortunately the financial crisis, which immediately followed, has adversely affected both the income from the Rockefeller endowment and any early prospect of substantial further support from American sources. Not only is the Station still without a suitable seaworthy boat and the means to maintain one—it possesses merely a little undecked motor-launch for inshore work—but the President of the Corporation, Dr. Conklin, has recently notified the Director that, owing to shortage of funds, the oceanographic programme must be indefinitely postponed, and his own appointment may have to be terminated.

After the high hopes with which the new Station was inaugurated this early check to its progress is very regrettable, since Bermuda admittedly occupies an ideal position for rendering immense service to the cause of oceanography, both as regards the circulation of the Atlantic waters and the conditions of existence of deep-sea and pelagic creatures. Especially as regards

the seasonal and annual fluctuations of the Gulf Stream, Bermuda stands like a watchtower in the Sargasso Sea, just where it could register these changes with the minimum of labour and expense.

In certain years, as the International Investigations have shown, the North Sea, the Norwegian Sea, even the Arctic Ocean, are flooded with warm, salt, Atlantic water; in other years the Atlantic influx fails. The disturbing effect of these annual variations on the climate, weather, and fisheries of Northern and Western Europe are too familiar to need elaboration here. The variations themselves at present are erratic, unaccountable, and unpredictable. But this is mainly because it has been no one's business to make the necessary observations and co-ordinate them.



The Sargasso Sea, showing surface currents, lines of equal frequency of drifting Sargasso (both after Krummel), and the distribution of the growing larvæ of the European Eel (after Schmidt). Broken lines represent Sargasso frequencies (as percentages of log-records examined). The western coasts on which fixed Sargasso grows are marked with a double contour. Continuous lines represent the limits of distribution of eel-fry up to the sizes given (10, 15, 25, 45, 60 mm.). These figures are placed on an imaginary curve which marks the presumed main axis of migration.

Although the factors are numerous and complicated (cf. DICKSON, *Phil. Trans.*, 1901), sufficient is known to admit of their division into two groups: (1) primary, those which determine the temperature and salinity of the mass of water in the central Atlantic west of the Azores, i.e., the Sargasso Sea; and (2) secondary, those which determine the direction and volume of the Northward Drift. A mass of water from the former source must be banked up against the continental shelf in more northern latitudes before an Atlantic invasion of the coastal waters can occur.

Now, in spite of a general uniformity of conditions throughout the Sargasso Sea, there may be great secular changes in the distribution of temperature in its water-layers. An example of this is given in MURRAY and HJORT'S *Depths of the Ocean*. Re-investigating, at the same time of the year (June 21st-25th), one of the old *Challenger* stations halfway between Bermuda and the Azores, the *Michael Sars*, in 1910, found temperatures below the surface some 4 or 5 degs. below the corresponding *Challenger* records in 1873. Surface (22 degs.) and bottom (4 degs.) temperatures were unchanged, but the 15 and 10 deg. isotherms were at least 100 fms. deeper in 1873 than in 1910. This huge difference may confidently be attributed to an exceptional strength of the cold Labrador current in the latter year.

If the *Michael Sars* had been able to extend its observations further west, it is more than probable that it would have found a state of things off Bermuda closely comparable with that south of Newfoundland, for the "cold wall" extension of the Labrador current here runs between the Gulf Stream and the coast, but in the opposite direction, and an increase in its strength could not fail to affect the temperature gradients in the Gulf Stream and adjacent waters far beyond Bermuda (cf. WYVILLE THOMSON'S *Atlantic* I, Pl. IX).

These examples and references may serve to illustrate both the magnitude of the annual fluctuations in the amount of heat stored in the waters of the central Atlantic, and the nature of the two great primary factors which determine them. Obviously it is in the western half of the Sargasso Sea, where equatorial and arctic currents meet and struggle, that the first variations are induced, and where, in consequence, it would be of immense value to maintain a continuous register of the resultant hydrographic conditions. Such a register would serve many purposes in connection with related problems, and would serve also to co-ordinate the discontinuous data collected by research steamers on special or seasonal cruises.

Wrecks have been known to drift from New Jersey to the Hebrides in less than a year; others off the Virginian coast to take eight months in drifting east to the 40th meridian, and thereafter over two years in making

an erratic clockwise circuit of the Sargasso Sea. Probably a better idea of the time-requirements involved is to be got from the drift of eel-fry from their birthplace in the Sargasso Sea, as elucidated by the late Johannes Schmidt. Hatched in spring, they spread over the central zone of the Sargasso Sea during their first summer's growth (25 mm.), but mainly towards the west at a depth of about 100-150 fms. At this stage they are common around Bermuda. At about a year old (c. 40 mm.) they approach the surface and are carried eastwards in their second summer to the central Atlantic (50-55 mm.). A third year carries them full-grown (c. 75 mm.) to the coastal banks of Europe, where they turn into elvers and ascend the rivers (comp. DISCOVERY, Sept., 1934, p. 257).

This marks a noble army of workers, institutions, and research vessels, all contributing something to the common pool. But everywhere workers and ships are preoccupied with urgent local problems, and have little or no time to give to wider matters. Without diverting them from their immediate tasks, what, then, is possible in order to get their contributions focused on the outstanding general problem we have defined, and to secure a concentration of effort for its solution? The answer in a word is " Bermuda ! "

Of recent years the International Council for the Exploration of the Sea, which has done so much towards elucidating the fishery problems of Western Europe, has been devoting increased attention to the organisation of work in the Western Atlantic. A special committee of the council is in active co-operation with a North American Council on Fishery Investigations, which includes representatives of Canada, Newfoundland, and the United States. The American Oceanographic Institute, with the research steamer *Atlantis* makes periodic cruises from Woods Hole for the investigation of the Gulf Stream and coastal waters, and the Newfoundland Fishery Research Commission is working actively on similar lines across the Labrador current and the Grand Bank. Both are revealing great variations in the Arctic and Atlantic currents in their respective areas, with profound repercussions on the local fisheries. On the European side, Spanish, French, British, German, Scandinavian, and Russian vessels have been systematically sampling the varied waters off their respective coasts for many years.

It is certain that if an oceanographic programme of this sort could be organised at Bermuda, in co-operation with the International Council, it would yield results of great value. A few years of experimental work under sea conditions of sufficiently varied type might even suffice to enable the main oceanographic conditions of N.W. Europe to be foretold six months or a year in advance. Imagine the influence of such knowledge on the problems of fishery forecasting and long-period weather prediction!

For the continuous programme here suggested the Director would obviously require an additional scientific assistant, preferably two assistants, a chemist for the hydrographic work, and a systematic biologist for the plankton. The Station also would need a much larger collection of oceanographic literature than at present it possesses. It lacks almost all the standard systematic monographs as well as the Reports of all the great expeditions, except the *Challenger*. Broadly, and without going into minor details, we estimate that the programme could be carried out by the provision of an additional sum of about £2,000 for boat, equipment, and library, and of an additional income of about £1,250 per annum for a period of five years in the first instance, to cover maintenance of the boat, additional staff, etc.

A Worthy Appeal.

Steps have been taken to invite consideration of the situation by the Development Commissioners, but the prospect of favourable consideration will be greatly enhanced if we can go to them with substantial evidence of general interest in the object before us. Dr. Gurney and I have accordingly opened an account to be called " The Bermuda Station Oceanographic Fund," to which we hope that our scientific colleagues will contribute as liberally as possible, as well as every member of the general public to whom this article may suggest an object worthy of special support.

The appeal, now launched through the friendly offices of DISCOVERY, starts with the support of the President of the Marine Biological Association of the United Kingdom, the Right Honourable Lord Moyne, P.C., D.S.O., and of the two British trustees of the Bermuda Station, Dr. E. J. Allen, F.R.S., Director of the Plymouth Laboratory, and Prof. J. H. Ashworth, F.R.S., Professor of Natural History in the University of Edinburgh.

Cheques, or promises of definite amounts, may be sent to the Editor of DISCOVERY, who has kindly promised to receive them, or to either Prof. W. GARSTANG, 18, Apsley Road, Oxford, or Dr. R. GURNEY, Bayworth Corner, Boars Hill, Oxford. We undertake to return all donations if for any reason the proposed scheme of assistance should not materialise.

Some friends of the scheme may be able and willing to contribute particular systematic monographs or other oceanographic literature. Promises of such works would be as welcome as subscriptions of money, but the books themselves should not be forwarded until further notice.

Book Reviews.

Every Garden a Bird Sanctuary. By E. L. TURNER. (Witherby. 5*s.*)

Miss Turner's books are well-known to ornithologists. The object of this little volume is, she tells us, to encourage bird-lovers to take an even greater interest in birds, and to make others appreciate the necessity for their preservation. Birds have many enemies: cats, squirrels, and some of their own species. But the worst enemy is man, with his bungalows, traps, gamekeepers, motor cars, oil refuse, and overplanting with conifers, not to speak of the unspeakable collector, whose acts of vandalism are unfortunately still condoned by some scientific ornithologists.

Miss Turner is convinced that the protection of birds in the future will depend upon the zeal and energy of the smallholder, the suburban dweller and the owner of larger estates. The properties belonging to the National Trust also help in this way, though, as Miss Turner suggests, portions might be enclosed and kept quiet during the nesting season. She specially commends the Hawksmoor Nature Reserve, which is intelligently administered and is self-supporting.

The book contains much expert advice about how to make small gardens or larger areas attractive sanctuaries for birds, including the selection of bushes and trees which provide food, shelter, or concealment. I have found macrocarpa hedges a very popular breeding place for various species. There is also a very sensible chapter about bird-baths. Many people still do not recognise that water is as essential to birds as food, and particularly in drought or hard weather. The important subject of nesting boxes is also dealt with, and diagrams of various patterns are given. The hints on what kinds of food attract different birds are valuable. My own experience has taught me that robins are as fond of sultanas as of meal-worms, and that earwigs, which may be collected in a jam jar, are also considered a delicacy by them.

I hope this little book will induce many who are "fond of birds" to make their gardens, however small, into sanctuaries. Mine has been one for many years. They will find that birds can be a never-failing source of interest and delight. As Miss Turner says, "the heart of the bird-lover never grows old." The index, so often irritatingly omitted from bird-books, is adequate.

E. W. HENDY.

Go Home, Unicorn. By DONALD MACPHERSON. (Faber & Faber. 7*s.* 6*d.*)

In a recent address Sir Richard Gregory complained that Science, as such, found but scant room in general literature. Mr. Macpherson's fantastic novel helps to meet his requirements, for its plot revolves around a biological laboratory, and the phenomena described are the direct outcome of scientific experiments. To choose the city of Montreal, "the romantic metropolis of a hard-headed race," as a setting is a distinctly clever touch in this scientific fantasia.

The mixture of old-established science with manifestations of the "substance that is between thought and matter," is ingeniously carried out; and, lest the scientific reader should resent the introduction of such a substance, Dr. Julian Huxley and Dr. Fraser-Harris (whose writings are well known to DISCOVERY readers) are cited in support of its existence.

Professor Brooks, the hero of the romance, is a well-drawn sketch of the open-minded young scientist of the day and McTavish, the journalist, is a good foil. In their search after the cause of the ectoplasmic manifestations (some gruesome, some ess serious) they meet with plenty of thrills. The ladies of the party, Olive and Mary, are well differentiated in character, though it requires a materialisation of the title-beast to disclose another difference. This incursion from the realm of the mediæval bestiary may be criticised as being a trifle far-fetched, but it does make for excitement.

Rats, Lice, and History. By HANS ZINSSER. (Routledge. 10*s.* 6*d.*)

Mr. Zinsser reverts, in his title-page, to the time-honoured explanatory system; and we are informed that the real purpose of this book is to be the Life History of Typhus Fever. But twelve preliminary chapters have to come first, for the preparation of the lay reader.

The lay readers who have to be prepared are the American *intelligentsia*, grounded more firmly in their country's modern literature than in the history of science. It is the author's evident intention to astound them, and we should estimate that he does so. Beginning with two chapters of general dissertation on the theme of why a scientist is a scientist (with much erudition and citation of good authorities), he proceeds to demolish modern American writing, from Paul de Kruif downwards, ending somewhat cruelly with the *envoi*, "There is no arsphenamin for psychic treponema." Meanwhile we approach the theme-subject from a long way off, and with much discursiveness: a chapter on bacteria gives rise to a brief history of speculations on the origin of life; another on parasitism in general affords scope for poking fun at the reader. The section dealing with the change of characteristics in epidemic disease—the rise of new ones and the decay of old ones—is entertaining but exasperating (probably with intention). But even the detached Mr. Zinsser has his fads: we feel dubious concerning his estimate of the waning power of measles, and many learned doctors might take exception to his dismissal in a few words of the neurotropic argument against adolescent primary vaccination.

However, we do soon come to the title features: rats come in with bubonic plague; typhus emerges in Chapter 8; and the ouse, "this not unattractive insect," appears in Chapter 9. The author really appears to have almost a Swiftian misanthropy and a sneaking admiration, coupled with awe, for the lice and rats . . . except that the latter have much in common with the human race.

After a lot more fun the book really gets going with the history of typhus fever in Chapter 12, and this is the part really worthy of consideration. A most interesting series of authorities is quoted and the evidence discussed. Very significant is the distinction between the various infection-chains of the different forms of Rickettsia disease, throwing light on the question of whether a form of typhus was endemic in America before the advent of the *conquistadores*. The answer to the question, "Were the Aztecs lousy?" would appear to be in the affirmative. A vigorous sketch of the triumphant progress of typhus through Europe from the 16th to the 19th century, and its last savage stroke in the Great War, adds an appropriate finale to an interest-compelling work which should have been half the length.

Man and the Machine. Edited by HUBERT WILLIAMS. (Routledge. 6s.)

Some maladjustment in the organisation of society which will not permit developing mechanisation to remain what it must be in essential meaning—the *tool* of man—is the *raison d'être* of this book.

Hubert Williams in his introduction describes the aim of the book thus: "it is to cast a certain amount of light . . . on certain aspects of the machine and its impact on ordinary men and women," and the machine is quite simply defined as the rapidly changing industrial conditions and methods of the post-war period.

The book is of importance at this period, particularly in view of the recent discussions at the I.L.O. in connection with the forty-hour working week, when this question as to the good or bad effects of mechanisation came fully into the foreground. Readers, however, who expect to find here a scientific analysis of the results of rationalisation will be disappointed, for it is an attempt to assess, on the basis of diverse personal experience only, the effects on those concerned in industry of the recent advances in technical efficiency.

Its main value lies in its importance as a *gesture*—it is an introduction to an unexplored region, a subject upon which no intensive study has as yet been published. It is already agreed that there are dangers in uncontrolled mechanisation of production, danger to the health and peace of mind of the actual workers, as well as danger due to a disequilibrium between production and present-day distribution, but no study of the *personal* effects on employees on the basis of that agreement has as yet been attempted. It is an enquiry, therefore, that should not be missed either by those who are concerned at the rapidly changing nature of society or by those interested in the actual personal effect of modern industry upon the individual.

Practical Everyday Chemistry. By H. BENNETT. (The Chemical Publishing Co., New York; W. & G. Foyle, London. 10s.)

It frequently happens that information concerning the nature and preparation of common commodities and commercial preparations is required; and such information is often difficult to obtain. In *Practical Everyday Chemistry* are collected together recipes for a very large number of materials in everyday use; the instructions are sufficient, in the majority of cases, to enable these materials to be made with the apparatus at the disposal of the average individual.

Over two thousand preparations are given, of which examples are adhesives, insecticides, fertilisers, lacquers, paints, enamel, cosmetics, drugs, beverages, cheese, inks, leather, cement, photographic materials, plating accessories, soaps, and dyes. The uses and methods of application of many of the articles are considered, and, where the small-scale preparation of a substance is likely to prove difficult or inconvenient, the commercial manufacture is described. Thus, for example, in the section on food the large-scale preparation of nineteen different cheeses is fairly fully dealt with.

The treatment of the subject matter is almost entirely practical; trade names are generally used in preference to chemical ones, and practically no attempts are made to describe the character of any of the chemical changes involved in the processes treated. The book is, in fact, not intended as a text-book for the serious student of chemistry, and the sub-title, "How to Make What You Use," is more descriptive of it than its main title. But it should be a useful handbook for those who desire to make up for themselves various articles in general use and a compact reference book for those who at times want to know of what certain common materials are composed; it might even be of interest, as the author suggests in the preface, to those who are looking for a new hobby.

An index and a list of suppliers of some of the "trade name" chemicals mentioned in the text are appended, but these are by no means complete.

The Place-Names of Essex. By P. H. REANEY, under the general editorship of A. MAWER and P. M. STENTON. English Place-Name Society, Vol. XII. (Cambridge University Press. 25s.)

Of the volumes published by the English Place-Name Society to date, that which deals with Essex is by far the most interesting and generally useful, not even excepting the preceding volume on Surrey, excellent as that was. For this, it may be said without in any way detracting from the credit due to the scholar whose name appears as the author, the basis afforded by the researches of the late J. H. Round and others only less well known is responsible in no small degree. By good fortune it was found possible to arrange for the incorporation in this volume of a large amount of material which had already been collected for an independent study of the place-names of the county.

The method and scope of this volume will be thoroughly acceptable to scholars. In particular the attention which has been given to field-names will be much appreciated, especially as in Essex these throw light in an exceptional degree upon a number of social customs and regulations in Saxon and early English times. One such custom, for example, perpetuated in this nomenclature is that by which a field was given to the bride on the morning after marriage.

As a whole the place-names of Essex are an epitome of English racial, social, and political history, in which the evidence from the archaic Saxon period and that of the Norman Conquest is more full than in any other English county. The Roman occupation has left its traces, outside Colchester, in the numerous "streets" and names, such as Stratford, derived from them; but Celtic names are surprisingly few and are mostly connected with the rivers or derived directly from river names (Colne, Stour, Pant, etc.), although Saffron Walden, Walton-on-the-Naze and others of similar character record the presence of the *wealas*, who may have been slaves, but more probably were Britons.

Saxon names leave an impression of great antiquity, and, it is thought, in many instances may go so far back as the period of the migrations. The distribution of names of the most ancient form and the incorporation of Thunor and Woden as elements in early place-names, such as, for example, Thundersley, indicate that the Saxons must have spread over the greater part of the area, that is now the modern county, at a time when they were still pagan. Such archaic names as Broxhedde, Swanstead and others, point to places of sacrifice.

The Norman Conquest and the manorial system were responsible for the introduction of a large number of French names, both of families and places. Among these, for example, are Beaumont and Pleshey, while Grays Thurrock, more commonly known simply as Grays, records a connexion with the Norman baron, Henry de Gray, dating back to 1194.

It is somewhat remarkable that the Vikings, who undoubtedly

raided Essex, left little trace of their presence in the form of settlements. Names of Scandinavian derivation, consequently, are few. They include several derivatives from personal names.

Though this volume appeals particularly to scholars, and will serve their need, whether archæological, historical, or philological, without fail, for the less erudite who have a turn for topography or antiquarian browsing it should prove a never-failing source of interest.

E. N. FALLAIZE.

The Discovery of Specific and Latent Heats. By D. McKIE, Ph.D., and N. H. DE V. HEATHCOTE, B.Sc. (Arnold. 6*s*.)

This little volume is a testament to the evident conviction of its authors that, in the study of science, there is room for a stronger emphasis on its human aspect than is generally given. It may well be that a study of the parentage, birth, and growth to maturity of a scientific theory may have high importance and value, and that we miss much in ignoring the man in relation to the idea.

Of the interest of such study, this work gives ample evidence—of the value, the reader must judge for himself. The essential distinction between heat and temperature having been perceived, Joseph Black, working at Glasgow University at the end of the eighteenth century, built up, patiently and unassailably, the evidence that there were differences in the capacities for heat of equal masses of different substances, and he established the existence of latent heats of fusion and evaporation.

No account of Black's work was published till four years after his death, when, in 1803, his disciple, Robison, edited his "Lectures on the Elements of Chemistry." Robison was greatly exercised lest credit should be filched from Black and awarded to others—in particular Wilcke, of Sweden.

The work of Black's contemporaries, Kraft, Richmann, Gadolin, and Wilcke is subjected to careful analysis by Dr. McKie and Mr. Heathcote, a task involving a translation of the original Swedish memoirs of the last named. As a result of the authors' immense pains and amazing industry in this direction, Black's right to priority in the field is placed beyond question.

But *cui bono?* Black's fertile ideas are the natural outcome of disciplined experiment and bear the unmistakable stamp of originality and sincerity. Even had they proved to have been anticipated they could not on that score, have lost one iota of interest and value.

Relativity, Gravitation and World Structure. By Professor E. A. MILNE, F.R.S. (Oxford University Press. 25*s*.)

Astronomical research, in particular that of Hubble, has shown that the nebulæ are receding from us with velocities approximately proportional to their distances from us. This "law of nebular recession" is the basis of the concept of "expanding space." Milne, in his treatise, attacks the cosmological problem by a fundamentally new method and derives a solution from entirely elementary kinematical considerations.

In developing the kinematical method no appeal is made to Einstein's theory of relativity. The "constancy of velocity of light," the fundamental postulate of relativity, is not taken as an axiom; neither the experimental facts, which are usually the foundations of the "special" theory, nor the conceptual methods of the "general" relativity theory are used to derive many of the well-known relationships of these two theories. The transport by observers of invariable scales or clocks is not permitted; "We shall not employ the concept of the transport of invariable or rigid length-scales, because this is an indefinable concept." The observers may explore by means of interchange of light signals only. Milne shows quite clearly how this is sufficient for him to derive, though in new contexts, most of the formal relationships of the "special" theory. We are then introduced to the "cosmological principle," which states that equivalent observers will give the same description of the system of particle (or universe) relative to themselves. Each observer gives the description in terms of his own clock-measures or associated co-ordinates. Milne uses this principle to select the particular system that he wishes to investigate. He compares systems of particles obeying the "cosmological principle" with the astronomical universe, and it is his confirmed opinion that the astronomical universe must satisfy this principle.

By adding a free particle to the system and obtaining a description of the trajectory followed by the added particle, "a complete gravitational programme without recourse to 'field equations' or to any specific formulation of a theory of gravitation" is produced. The misleading "curvature" of space or space-time, and the notion that bodies are accelerated "because space is curved" are carefully avoided, because "space" and "space-time" have no real physical content. Naturally, therefore, the reader accustomed to current relativistic literature will find Milne's thesis difficult to follow until he has mastered the new underlying idea and the new language.

We cannot conclude without referring to the excellent concise description of the facts known about cosmic rays which is given in Chapter XII. This will appeal strongly to the physicist. Evidently the kinematic theory leads to the situation propounded by Bothe and Kohlhorster, viz.: "That cosmic ultra-radiation consists of corpuscles which are accelerated in intergalactic or interstellar space through fields of force over enormous distances."

One of the commendable features of the book is that almost every chapter concludes with a brief summary of the chapter's contents. It is also excellently printed and has both a name and a subject index.

A. C. MENZIES.

Relativity. By F. W. LANCHESTER, F.R.S., LL.D. (Constable. 12*s*.)

Dr. Lanchester's interest in Relativity, and in particular the Minkowski theory, dates back to 1908 when he first made the acquaintance of Minkowski himself at the home of the famous mathematician, Carl Runge. In 1921, two articles were published by Dr. Lanchester in "Engineering" in which he attempted to explain the Minkowski theory of space-time. Now, in his book, the object is to reconstruct and develop the theory anew beginning from the one fundamental postulate of relativity; viz., that the velocity of light *in vacuo* is a physical constant independent of the motion of the observer.

Part I of the book is devoted to the "special" theory of relativity. The author adopts the historical sequence and the reader is led by very easy stages from the old Newtonian ideas to Minkowski's four dimensional space-time, the Lorentz transformation, the Fitzgerald contraction, and the apparent change of mass.

The earlier part of Part II is an attempt by the author to give

an account based on Minkowski's work of the " general " theory of Relativity. The method outlined is entirely different from Einstein's and in some cases leads to results which are at variance with those of Einstein. Dr. Lanchester is everywhere careful to point out where these differences occur. The later chapters discuss without mathematical detail the method of transmission of gravity in space-time, rotation in the Minkowski continuum, the expansion of the universe, general space curvature and the Principle of Equivalence.

Dr. Lanchester does not hesitate to introduce mathematical expressions where necessary, but avoids the use of tensor analysis and higher mathematics. The whole is dealt with in an elementary manner and the less skilled reader need have no fear of not following the argument. The graphical geometry, the many clear and instructive diagrams, the simple examples and analogies which the author uses so skilfully, make easy what would otherwise be rather stiff going. The book, however, is not for those with no mathematical training whatsoever, but rather for the young student of science or engineering to whom the mathematical language will not be strange.

Much miscellaneous matter, e.g., the geometry of the hyperbola treated in a very elementary manner and a very interesting reprint of an article by the author on " The Expansion of the Universe," is relegated to the appendices, of which there are twelve. A useful index completes the work.

The book may be warmly recommended to those who, having read Einstein's popular exposition, " The Theory of Relativity," may wish to examine more closely some of the fundamental questions which the theory raises.

A. C. MENZIES.

The Materials of the Artist. By Professor MAX DOERNER. Translated by EUGEN NEUHAUS, Ph.D. (Harrap. 10*s.* 6*d.*)

This book, condensed from lectures given for nearly twenty-five years at Munich, is written with characteristic German thoroughness, and deals exhaustively with every material that can possibly be used in the painter's art. Yet it is full of touches of less directly practical interest. Most of Professor Doerner's remarks are highly valuable to painters—such as the advice to grind their own colours, and to guard against mixing incompatible colours, which makes for impermanence, also to have a palette of the same colour and tone as the canvas.

The chapter on the phenomena and effects of colour will, by many, be found the most interesting in the book; unlike the impressionists, painters of to-day study but little the scientific foundations of their art; this neglect accounts for much unsatisfactory work. They should read Professor Doerner's excellent remarks on the harmonising power of nature, and his advice to use the same colour-key throughout a picture, also his description of how light destroys local colour and shape.

There are minute directions as to many and various methods of oil-painting—especially " alla prima," and the author explains the reasons for each process, which adds greatly to the interest of his work.

For tempera, he recommends " natural " emulsions—made with egg and casein—rather than synthetic ones. For mural painting, he says, the fresco must not (as in an oil colour) create an illusion of space behind the wall.

There is an enthralling chapter on the technique of the Old Masters—old MSS. exist, one giving a recipe for extracting pigments from plants. Most of the old painters used tempera in their easel-pictures, some combined it with oil, but the Venetians, el Greco, and Velasquez made an under-painting of tempera (sometimes mixed with oil-colour), over which the picture was finished with resin-oil colour.

There is a useful chapter on restoration.

That this translation should appear in the same year as Professor Laurie's book, recently reviewed here, is a healthy sign of renewed interest in the technical side of art.

MARY BARNE.

Asylum. By WILLIAM SEABROOK. (Harrap. 8*s.* 6*d.*)

To save himself from becoming an incurable dipsomaniac Mr. Seabrook, the distinguished writer and traveller, voluntarily entered a large mental hospital in America. The spirit of " this great modern psychiatric institution " (which the author tries to persuade us he thinks of as an " asylum " from friendly feeling) is the keynote of Mr. Seabrook's book. The theme is his experience as an inmate.

His straightforward rendering of his relations with staff and fellow-patients is full of understanding and humour, which never borders on the unkind or the offensive. He has his likes and dislikes, of course, and does not hesitate to say so; and he even suggests that much of modern psychiatry is " hooey " and " baloney." However that may be, it has certainly succeeded in removing much of the dark stigma that once attached to pathological mental or nervous cases and it is good to read that " nine-tenths of the patients—including some with the most fantastic hallucinations—have gone out of that institution, or will go out, cured and sane." The account of one or two almost " miraculous " cures is of the highest human interest.

More special in appeal is the description of the method by which the author's loss of control was cured—seen from the patient's point of view. It would be interesting to know the result of a comparison of notes between Mr. Seabrook and a successful case of drink-mania emerged from Mount St. Bernard or Mount Melleray. It is likely that the stages through which the patient passes—the indifference, the exaltation, and the depression—would be much the same in either case.

The relations between the patients themselves seem to be most friendly, and they are quite prepared to give and receive chaff concerning their respective hallucinations; but Mr. Seabrook never had first-hand experience of the " back-halls " (local slang for the " disturbed wards ") and we have a description of them only from a couple of patients who had graduated to " Hall 2," the home of the rapidly improving cases. The glimpse they give into the depths of utter listlessness, when the patient is so hopeless that it is not even worth while to contemplate suicide, reveal an aspect of the case very different from the somewhat schoolmarmish atmosphere of the " front halls," which were as far as Mr. Seabrook penetrated. So does the verbatim description of one " disturbed case " by another, with its progressive lapse into Joycian language.

The non-repressive treatment of mental cases is, however, neither new or transatlantic. If Mr. Seabrook has heard of Gheel in Belgium, where mental invalids have mixed freely with the normal population since the 13th century, he does not mention it; but he does appreciate the fact that many lunatics of to-day, had they lived in the middle ages, might well have been canonised.

Future editions of this book, which should be of wide general interest, could be produced in a smaller size and at a lower price.

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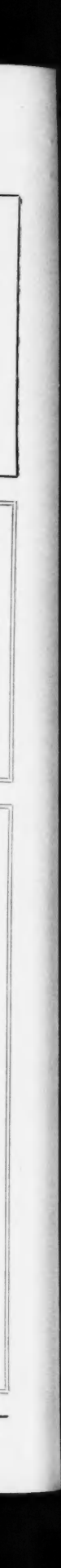
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